ENGINEERING NEWS

THE accident of Tuesday last on the 6th Avenue elevated road is not reassuring to travellers, as it was altogether chargeable to a hastily and imperfectly spiked rail and thus might have been avoided. Near the point of the accident a center third track is being put in with a switch at Leonard St. This switch was in place, but a rail near the switch in the up-track was being replaced by a new one and before the rail was properly spiked down again a train came in sight. The foreman of the gang "guessed the spikes in would hold" and let the train come on; but the spikes gave way, the rails spread and the engine and two cars left the track and ran about two car-lengths over the ties, stopping within 7 ins. of the ends of the ties. It is proper to state that the westerly heavy wooden guard rail had been removed to facilitate work on the switch and new rail. The alarming feature was that the east wheels of the two cars mounted to the top of the guard-rail in place and dangerously tipped the cars. No one was hurt but a train load of passengers were naturally much shaken up and alarmed. The roadway is 20 ft. above the street at the point of the accident and the street below was crowded with street-cars and vehicles. Moral:—don't carry passengers over a half-spiked rail and unguarded track.

THE plan for roadbed adopted on the Kansas City elevated structure seems well calculated to prevent, or at least mollify, similar derailment accidents. On that structure there are no crossties at all, we believe, but the rails are laid in an iron trough in such manner that should a car leave the track the trough would keep the train in line and support it to the station if necessary.

THE accident on the Consolidated Road at Portchester, last week, by the falling of a retaining wall, is described by the local press as being due to bad proportions in the wall and faulty workmanship. As the local editors are probably not posted in the proportions of retaining walls their opinions can be taken with a certain allowance. But as the wall is reported to have bulged at a height of 12 ft., while it was intended ultimately to be 30 ft. high, it does look as if some explanation was called for from the engineer, either regarding his own work or that of the contractor.

THE 9,000 ton timber raft abandoned off Block Island on its way from Nova Scotia to this port, is an especially ugly obstruction, or threat, to ocean navigation in this foggy Christmas weather. It is worse than an iceberg for it cannot make its presence felt until the discoverer is on top of it, and for all practical purposes the steamer might just as well strike a rock. Better safe-guards against total abandonment are demanded if the towing of huge timber rafts to this port is to become an established practice.

R. H. SOULE, General Manager of the N. Y. Lake Erie & Western R. R. Co., writes to the New York Railroad Commissioners that his company is "energetically prosecuting the study of the best method of heating passenger cars." Two trains are now running between Buffalo and Lockport equipped with the MARTIN system of heaters. Other trains are being equipped at Jersey City partly under the WILLIAMES system and that of the New York Safety Heating Co. Since the passage of the law the company has substituted the BAKER heater for the old-fashioned hot-air heater in a number of cases. One cause that has operated to delay the general introduction of steam heating is the absolute necessity of uniform couplings for the steam pipes and hose connections between cars from different railway systems. This question is now being considered by the principal systems.

THE slot of the cable road at St. Paul, Minn., is said to be playing the mischief with horses and cutters. It is so wide that the calks of horses' shoes are readily caught in it, with the result, if the horses are on a trot, of throwing them and sometimes breaking their legs or tearing off their hoofs. Accidents of this sort have already been numerous, and the stalls of the veterinary stables are receiving large accessions of equine patients which have been injured in this way. Quite a number of serious accidents have also resulted from the fact that the slim runners of cutters and sleighs will sink in the slots.

A NEW elevated railway scheme, covering a comprehensive system for all three divisions of the city of Chicago is said to be on foot among a New York syndicate representing $20,000,000 capital. The company is styled the "Chicago Remunerating Elevated Railway Company." It will propose to the City Council that, in lieu of municipal taxation and licence fees it will pay the city 5 per cent. of its gross receipts. Three cent fares will be the rule with transfers to any part of the city at one cent a mile. STEPHEN A. DOUGLASS is the Chicago representative of the syndicate.

A WISE reporter in describing an accident on the New Croton Aqueduct whereby a ton of dynamite was exploded near Shaft No. 16, sagely remarks in conclusion that "the dynamite was a total loss." It usually is under similar circumstances.

Mr. H. C. HALL, U. S. Minister to Central America, has forwarded to the State Department a report on the Panama canal made by Mr. SYLVANUS MILLER, incorrectly stated to be a member of the American Society of Civil Engineers. Mr. MILLER is said to have 15 years experience on public works in Central America and for 2 years has been superintendent of dredges at Panama for one of the larger contractors there. He says that out of a total estimated quantity of 125,000,000 cu. m. of excavation, there was still remaining to be done on July 1, 1887, 100,000,000 cu. m. Under economical management he estimates that this would cost $1.50 per cu. m., including cost of administration and engineering. The excavation remaining would thus cost $150,000,000; controlling the Chagres, $20,000,000; locks and harbor work, $10,000,000; contingencies, 10 per cent., or $18,000,000; or in round numbers a total of $200,000,000. In the paper of the Canal Company, this sum would probably represent $500,000,000 at 5 per cent. as the cost of the canal. The interest on this at 5 per cent. would be $25,000,000 and the maintenance and operation would be about $2,000,000, or a total annual charge of $27,000,000. Opposed to this he puts an annual traffic of 6,000,000 tons at $3 per ton, or $18,000,000, and thus shows an annual defect of $9,000,000. But Mr. MILLER thinks that the total expense will more probably reach $750,000,000 or perhaps $1,000,000,000. He finds great fault with the method of carrying out the work and says that on the lower sections of the canal below Matachin much of the canal dredged has been filled level with sand brought down by a 3-ft. rise in the Chagres. He says the canal is not impracticable from an engineering stand point, but it will cost enormously and be impracticable from a financial point of view.

IT seems impossible to discourage a certain class of inventors, and we may add railroad men, by any amount of experimental evidence. If anything has been settled by the Burlington brake tests, it is that no form of buffer or friction brake has the remotest chance of adoption, yet according to the Boston *Herald* "a party of 150 gentlemen assembled at the Boston & Albany depot on invitation of the Superintendent and the Turner-Beard Automatic Brake Co." and proceeded to solemnly test a short train of 25 cars fitted with brakes. Some rather poor stops were made in which there was "no shock," but "some of the chains were broken, *demonstrating the strength of the brake*" as the ingenuous reporter puts it, and the party separated; a dozen high railroad officials mentioned by name "*and other eminently qualified railroad officials* expressing themselves as being fully satisfied with the brake," to quote the reporter again. We hope this is not true, but anything may be expected of men who will waste a day on such a test of an entirely new device after all the teachings of the past.

THE statistics of the traffic arriving at Buffalo, N. Y., by lake and canal for the season just closed show that water carriage is still far from being an unimportant factor in the transportation of Mississippi valley products to the seaboard. The receipts of all grain, flour and wheat by water in 1887, were 102,914,775 bushels. The coal shipped by lake was 1,819,337 tons, the greatest traffic which has ever been recorded. The rate of freight has been the highest on record, being at $1.00 to $1.25 per ton to Chicago and 75 cts. to 90 cts. per ton to Duluth for most of the season.

HIGH tides at Galveston, Tex., have washed out 300 or 400 ft. of track laid as an experiment on a brush and rubble bed about a foot high; the portions of the track on trestle work were not damaged. The jetty sea-wall was uninjured. Portions of the Marshall, Paris & Northwestern Railroad, in Texas, have been flooded, but no washouts occurred, and the damage is slight.

ON Dec. 16 a snow-plow, locomotive and 4 cars went through a small bridge a few miles east of Fremont, Neb., on the Fremont, Elkhorn & Missouri Valley Railroad. The bridge was being repaired, but the engineer could not see the danger flag on account of the snow plow.

THE most serious railroad accident of the week was a derailment Dec. 17 on the Intercolonial Railroad. A passenger train from Caraquet, N. B., to Bathurst, found the track blocked by a snow drift on the west side of the bridge over the Caraquet river at McIntosh's Cove. The snow plow and locomotive were detached and sent ahead at a rapid pace to clear the track; both were derailed on the bridge and plunged through the ice into the river. It is believed that a wheel of the plow was broken and caused the accident; the bridge is a substantial one, built of cedar piles and is not thought to have been the cause of the disaster. Of 13 men on the engine 8 were killed, and the other 5 seriously injured.

QUITE a number of railroad collisions are reported during the past week. A serious collision occurred Dec. 15 in Fostoria, O., at the crossing of the Baltimore & Ohio and Ohio Central railroads. Six misplaced switch accidents occurred.

ADVICES from Calcutta say that the railroad over the Khojak Pass to the Afghan frontier is to be commenced at once. The distance is only 15 miles, but the line includes a tunnel 2½-miles long, and two years is the time mentioned for completion. The ruling gradient is 1 in 40. Mr. O'CALLAGHAN is the Chief Engineer.

PRIVATE bill legislation in England will not be very heavy in session 1888. Plans have been deposited in respect of only 58 railroads, but none of the new schemes will command great interest.

A CURIOUS but very serious accident happened at Rochester, N. Y., on Dec. 21. The Vacuum Oil Co. attempted to pump naptha from their tanks through a 2-mile conduit to the Municipal Gas Co., but after 14,000 galls. had been pumped it was reported from the gas company that no naptha had been received. By some accidental leak this quantity of inflammable material had escaped into the city sewers with terrific and fatal results. About 3 P. M. the heavy stone cover of a sewer manhole was blown off with a loud explosion, and this was followed by the blowing up of about 40 other manholes, over 4 miles of sewers and explosions under the Clinton Flouring Mill, which set that structure on fire. Four persons were killed and over 20 persons badly injured by flying fragments of paving, etc. The peculiar disaster caused great excitement and almost justified the thought of some that the final judgment had really come.

As an outcome of the late conference at Domo d'Ossola between the Swiss and Italian delegates for the proposed Simplon tunnel, it is stated that a financial contract has been concluded in Paris for the construction of the tunnel. If Italy agrees to give the 15,000,000*f.* desired, it only remains for the Swiss and Italian Governments to conclude the necessary convention; and it is even hoped that the work may be actually commenced in the coming spring.

Excessive Monthly Precipitation for October.

The following data accompanied the letter of Gen. GREELY on this subject, elsewhere published.

With a view to the arrangement of the rainfall data of this office in such a manner as would best tend to the interests and add to the information of the engineers of the country and other classes interested in extreme rainfalls, there has been collated for the month of October for a series of years (for the most part ranging from ten to sixteen) data showing the greatest rainfall that has occurred in any October: cases in which 2.50 ins. of rain have fallen in twenty-four hours, and also instances where the rain has been so excessive as to equal or exceed the rate of an inch per hour. These data apply only to extreme cases in October, and while they give a general idea of extreme amounts of precipitation for month, day, and short periods of time, yet the lack of rainfall stations and long records prevent the data from being entirely exhaustive.

It is found that rainfalls exceeding 10 ins. have occurred in October at various points contiguous to the sea coast of New England and at scattered points throughout the whole extent of the south Atlantic and Gulf states, as well as on the Pacific cost northward of the fortieth parallel. In central Illinois and northern Arkansas, amounts exceeding 10 ins. have also fallen.

The first table shows for October all monthly rainfalls exceeding 10 ins. as well as the maximum amount fallen, at any station in the various states and territories:

It has also been found from examination of records that rains of 2.50 ins. and upwards in twenty-four hours in the month of October during any year since the commencement of reports have fallen as follows

At various points in New England, especially in the coast regions, at Mount Washington, and in and near the Connecticut Valley; in the middle Atlantic states adjacent to the coasts, in the valleys, along the rivers, and on the western shore of Chesapeake Bay; on the coasts of the south Atlantic states, near the rivers and in adjacent valleys, on the mountain slope in western North Carolina, and in southwestern Georgia; in northern and eastern Florida and at Key West; in the Gulf States, especially on the coasts, and in Louisiana, also in numerous places inland on and adjacent to rivers; near the mouth of the Rio Grande; on the Pacific coast northward of the fortieth parellel; inland at points on or near the Mississippi River, from Memphis, Tenn., northward to the southern border of Wisconsin; in the Ohio Valley and Tennessee, especially adjacent to rivers; along and near the western tributaries of the Mississippi east of the one hundredth meridian, and from the west Gulf states northward to Omaha, Nebr; in the valley of the Red River of the North; at Chicago, Ill., and in southern Michigan peninsula; on the southwestern shore of Lake Erie, and at Buffalo, N. Y.; also at three stations near the one hundred and fifth meridian, viz., Deadwood, Dak., Pike's Peak, Colo., and Fort Davis, Tex.

The second table shows the amount of excessive rainfall, at the rate of 1 in. or more per hour, during the month of October at any station during the years stated:

Table No. 1.—Monthly Rainfall Approaching or Exceeding 10 Ins.

State or Territory.	Station.	Amt.	Year.	State or Territory.	Station.	Amt.	Year.
Alabama	Montgomery	10.20	1879	Montana	Fort Maginnis	4.06	1883
do	Greensborough	9.85	1879	Nebraska	Omaha	5.86	1877
do	Green Springs	9.85	1879	Nevada	Fort McDermit	6.33	1883
Arizona	Fort Apache	4.68	1880	New Hampshire	Mount Washington	18.38	1881
Arkansas	Lead Hill	18.11	1883	do	do	12.91	1884
California	Fort Gaston	12.50	1876	do	do	11.11	1885
do	do	9.02	1882	do	Weir's Bridge	11.80	1869
Colorado	Pike's Peak	4.64	1880	do	Lake Village	11.54	1869
Connecticut	New Haven	10.00	1887	New Jersey	Orange	7.19	1887
Dakota	Webster	9.39	1882	New Mexico	Santa Fé	4.19	1881
District of Colu'bia	Washington City	8.69	1885	New York	Rochester	8.67	1873
Florida	Key West	9.27	1870	North Carolina	Salisbury	14.19	1887
do	do	14.20	1879	do	Weldon	9.97	1887
do	do	19.77	1883	do	Hatteras	9.99	1878
do	Jacksonville	9.45	1879	do	do	12.00	1880
do	do	16.25	1880	do	do	10.28	1885
do	do	10.30	1882	do	do	11.07	1887
do	Cedar Keys	10.37	1880	do	Raleigh	10.23	1887
do	Merritt's Island	11.30	1879	do	Chapel Hill	11.21	1887
do	do	11.82	1883	do	Lumberton	9.51	1887
Georgia	Savannah	9.45	1876	Ohio	Wauseon	8.92	1881
do	Leo	10.05	1879	Oregon	Astoria	13.40	1875
do	Raburn Gap	19.40	1879	do	do	14.20	1876
do	Ellersile	10.50	1885	do	Portland	10.53	1876
Idaho	Boisé City	4.06	1883	do	do	11.63	1882
Illinois	Springfield	10.02	1881	Pennsylvania	Erie	8.17	1885
do	Mattoon	11.25	1881	Rhode Island	Narragansett Pier	8.14	1883
do	do	9.40	1883	South Carolina	Cheraw	10.11	1887
do	McLeansborough	9.28	1883	do	Charleston	14.31	1876
do	Greenville	9.52	1883	Tennessee	Memphis	8.56	1883
Indiana	Indianapolis	8.56	1883	Texas	Brownsville	15.71	1884
Indian Territory	Fort Gibson	8.30	1877	do	do	16.27	1887
Iowa	Keokuk	8.01	1881	do	Galveston	17.78	1871
Kansas	Atchison	9.20	1870	do	do	17.39	1877
Kentucky	Louisville	8.05	1883	do	do	10.83	1881
Louisiana	Shreveport	9.30	1877	do	Palestine	9.96	1882
do	Point Pleasant	13.04	1880	do	New Ulm	11.31	1877
do	do	13.69	1881	do	do	12.44	1881
Maine	Gardiner	13.15	1855	Utah	Salt Lake City	3.27	1876
do	do	12.67	1869	Vermont	Croftsbury	10.72	1869
Maryland	Woodstock	8.23	1885	Virginia	Norfolk	11.36	1872
Massachusetts	Worcester	9.81	1869	do	Variety Mills	10.76	1885
Michigan	Alpena	13.18	1877	Washington Terr.	Tatoosh Island	9.03	1884
do	do	10.25	1881	do	do	11.83	1887
Minnesota	Saint Vincent	6.61	1878	do	Neah Bay	14.94	1887
Mississippi	Natchez	12.43	1877	West Virginia	Helvetia	5.80	1885
do	Vicksburg	9.69	1881	Wisconsin	Madison	9.12	1881
do	Hazlehurst	10.20	1887	Wyoming	Fort Laramie	3.14	1874
Missouri	Saint Louis	7.51	1885				

Tabla No. 2.—October Rainfall of One or More Inches Per Hour.

Year.	State.	Place.	Date.	Duration. Hours.	Duration. Min.	Total Amount.	Rate per hour.
						Inches.	Inches.
1880	Illinois	Springfield	25	0	06	0.23	2.30
	Nebraska	Howard	13	0	50	1.38	1.65
1881	Texas	Brackettville	2	8	00	10.97	1.37
	Kansas	Fort Scott	2	0	20	1.80	5 40
	Indiana	Vevay	4	0	40	1.20	1.80
	Illinois	Swanwick	6	1	45	2.25	1.28
1882	Missouri	Pro Tem	2	1	35	1.50	0.98
	Texas	San Antonio	8	1	10	1.70	1.45
	Alabama	Mobile	31	5	00	5.20	1.04
1883	Kansas	Holton	1	1	05	2.50	2.30
1887	Florida	Titusville	19-20	3	12	3.92	1.22
	Texas	Abilene	7-8	2	30	2.39	0.90

THE London *Standard* says that one day of a London fog costs from $25,000 to $40,000 in extra gas burned by the consumers. The extra gas furnished by one company, of the three serving London, was lately 35,000,000 cu. ft. in excess of the demand for a clear day.

Water Supply and its Development for Small Cities in the West.*

It is the object of the present paper to consider the question of a water supply and its development in the interest of the many thriving communities throughout this and adjacent parts of this Western country, and to do so in the light of past experience.

It is but fair to assume at the start that those who are making a special study of public water supplies, cannot fail to possess information of interest and importance to impart to the general public when circumstances permit. In the present instance any suggestions are intended to be offered in an impartial and popular manner.

So many towns have failed to realize their anticipations in securing a public water supply, particularly when ground water has been the source, that the town authorities seem either to have been ill advised or to have misapprehended actual conditions.

In some cases of failure, to the writer's knowledge an adequate and tangible supply of water was experimentally determined, but by a neglect or ignorance (probably the latter) of the natural laws governing the flow of ground water, and inappropriate method of development, the requisite and expected supply was not, on test, forthcoming.

An experience gained by one or several successive failures is expensive and undesirable. Small towns can little afford to pay for information on such matters two or three times its market value. It is much better to preclude all probable chances of failure by a through and systematic investigation.

No matter what the size of the town may be, this question of a water supply involves the health, happiness and protection of the community, in a manner that appeals to the best and most disinterested deliberations of the town authorities.

Small communities rely on cisterns and wells, and often cling to the use of them when the growth of the town should suggest something better. Cisterns are usually for the storage of rain water, and many suppose that from this source comes the purest and best supply for domestic uses, because this water is precipitated from vapors in the air. This view is all very proper, when it refers only to the use of the water for ordinary kitchen and toilet purposes; but, if drinking and dieting are also included, it is an erroneous one, for the reason that noxious and soluble gases and fine dust emanating from animal and vegatable life, from the decay of organic substance; from the disintegration of mineral matter and from fuel combustion, are as native to the air, as sediment is to a flowing river, and the rain, as it descends, absorbs atmospheric impurities, surrounds them with conditions favorable to chemical action, and reaches the earth in a state of greater or less impurity.

Even this source of pollution need not render rain in the vicinity of small towns, unfit for domestic use, were it kept from other contaminations; but, on the contrary, by contact with painted and dirty roofs and gutters on the way to the cisterns, and the great liability of those receptacles to the percolation of surface water, additional sources of pollution are encountered.

Within the cisterns the conditions are unfavorable for the circulation of air and water, and any gases arising from the enclosures are readily absorbed. Thus it is that rain water, by the time that it is used can become exceedingly impure.

Open wells draw towards them the ground water from considerable distances in all directions, and, when in the vicinity of cesspools and privy vaults, become a receptacle for their sub-surface drainage. It is commonly thought that water by percolating through the ground will become pure. This idea, however, must have its limitations, for water to be purified by natural filtration must pass through porous and well drained soils permitting of a free circulation of air, and the process of oxidation; but when draining through or from deposit vaults into the deep sub-soils, it is simply filtered and may enter a neighboring well perfectly clear, but most dangerously foul with the matter in solution.

It may be thought that driven wells, because of the iron encasing tube, are exempt from such dangers of pollution, but it is not the case, because, there being no storage capacity to a driven well as in open wells, a depletion of the soil extends in all directions

* By WINKOOP KIERSTED; read before the Engineers' Club of Kansas City, November 7.

immediately upon draft, and this depletion is more extended, the greater and more continuous the operating power attached to the well, so that it is only necessary for the drainage from vaults in the vicinity to reach this affected district, in order to find access to the well.

Cisterns and wells are of course a necessity in the early history of a community, but they demand constant vigilance as the price of freedom from contamination; and in estimating the quality of the water from either source it is never safe to depend on appearances, for though the water from them may be clear and sparkling, it is not, for all this, necessarily pure, even sewage water may be clear as crystal.

Both methods of water supply can well be discarded for everything but the most ordinary house uses, as soon as the town can afford to procure water from some safe and reliable source.

The waters of drainage and percolation, collected naturally in rivers, lakes and porous sub-soils, are the immediate sources of large local supplies, and may be divided into surface and sub-surface supplies, and even these facilities are more or less limited according to the location.

Of the surface supplies, the best comes from some one of the large rivers. These waters, by flowing over and through uneven beds of silicious sand and gravel of considerable slope, and by being brought continually in contact with the air, are freed from organic matter by oxidation. The retained impurities are chiefly sediment in suspension, which are readily disposed of by settlement in basins or by filtration. What hardness there may be in such waters is usually not sufficient to interfere with general domestic service. The intake from such a source should be located in a main channel, at a point above the town, where pollution from sewage and manufacturing waste cannot reach.

Lakes, in this Western country, if they exist at all, are usually unfit for furnishing good water and can scarcely be considered here.

Circumstances sometimes favor impounding reservoirs, which store surface waters collected from a more or less extensive water-shed. Such supplies are desirable where the impounded water can possess depth, at the expense of superficial area, and can be free from contact with vegetable soils and polluted surface drainage. When the drainage valleys are broad, the stream burdened with sediment, the vegetable soils deep and the sub-soils porous, the conditions are very unfavorable for the construction of dams and the storage and maintenance of pure water.

Many inland towns are so situated that surface water either cannot be obtained at all, or it is at an expense beyond their present means: consequently, resort must be had to sub-surface supplies, and these may be both from deep and from shallow sources.

The deep sources furnish water by means of artesian wells, from the ancient geological formations, consequently it is liable to the impregnation of mineral matter.

The shallow supplies, often in considerable quantities, come from the drift formation of sand, marl and gravel, from 50 to 150 ft. in depth, and are usually good for all house purposes.

In locating a water supply of this kind, caution is to be observed, for absolute reliance on a yield from such a source is extremely hazardous, unless preceded by a thorough and skilled investigation.

In the first place, the laws governing ground water flow are to be strictly observed, and are practically the same as those governing the flow of surface waters. The movement of the water through the ground, however, is very slow, due to the great resistance of the soil; and this resistance varies with its degree of fineness, for instance; water will pass very freely through a mass of bowlders or coarse gravel; more slowly through sand; the rate of flow decreases as the material becomes more finely divided; clay permitting very little to pass.

TO BE CONTINUED.

GERMAN papers are just now talking much about the introduction on their railways of what is practically our "mileage ticket." They are issued in little books each leaf good for 5, 10, 50 or 100 kilos of travel. The gain by purchasing them is 25 per cent. for 1,000 kilos, 33 per cent. for 2,000 kilos and 50 per cent., or half fare, for 5,000 kilos, or 3,100 miles. The holder of this book of coupons is identified by a photograph pasted upon the book and by his signature.

The Protection of Underground Pipes of Small Diameter.

A writer in *Le Genie Civil* comments on the elements combining to destroy pipes of cast-iron, wrought-iron or lead, when used underground as conduits for water, gas, compressed air or electric wires. He classifies these destructive agents as humidity, oxydation and settlement and disturbance of the earth from city work, and the constant movement of vehicles, etc.

Cast-iron pipes last the longest, but being in comparatively short lengths the number of joints is augmented, they are expensive, easily broken and it is troublesome to make them of small diameters. Wrought-iron pipes have the advantages of rigidity, come in long lengths and are little deformed by pressures. But on the other hand wrought-iron pipes rust easily, and their mean duration is from 3 to 8 years according to the soil in which they rest. Lead pipes have the advantages of practically no intermediate joints, resist oxydation and chemical action well and are easy and inexpensive to lay. But their malleability is an objection as they are easily deformed in shape when used underground, and are at times ruptured by these pressures. While the Bower—Barff process, though expensive, will protect wrought-iron pipes against oxydation, it is powerless against the physical deteriorations to which underground pipes are subjected.

The author then recommends for branch pipes a system of wrought-iron pipes laid in wooden troughs. These troughs can be either square or rectangular; and be made of solid blocks hollowed out, or of small boards nailed together, from ¼ in. to ⅝ in. thick. The wood used should be protected by a tar coating or chemical injection, and they should be connected by splicing boards nailed fast. All the space about the pipe should be filled with melted rosin mixed with saw-dust or sand. Under certain conditions the wooden trough could be replaced by earthenware or even light castings containing the isolating mixture.

M. ALEXANDRE LEON has used in this connection special boxes of wood to be used without iron pipes, to which he has given the name of *tuyaux flamands*. The wood is injected with creosote. The box itself is hollowed out of the solid block, being U-shaped in section, with a covering lid of wood. The lid is made to break joint and is nailed fast and further rigidity is secured by a small sill placed under the joint.

This protecting box, filled either with the before-described mixture or with tar, is especially recommended for electric cables. The advantages claimed are:—efficient protection against shock, external pressures and sinking of the earth, and they guarantee the metal against all oxydation and deformation and greatly increases the duration by consequence.

The Grace Contract in Peru.

A late editorial in the London *Financial News* states that the GRACE contract after lately breaking down a strong London syndicate and upsetting a Peruvian ministry "has come up again smiling."

The *News* says that the general principle of this contract has always been admitted to be sound, and it was based on the fact that Peru, being unable to meet its financial obligations, had agreed to hand over to its foreign creditors certain properties to administer for their own benefit. The only question was whether the proffered pledges were worth taking and how a safe title to them might be secured.

The most important of the concessions were eight separate lines of railway running from the coast to the interior, and at least four of these were large undertakings already yielding good returns. Taking three in the order of their magnitude, we have first the Southern Railway system, from the port of Mollendo to Juliaca, near Lake Titicaca, where it forks north and south, to Santa Rosa and to Puno. At present 408 miles are opened, and at last official returns the gross receipts were $750,000 per annum, and the net receipts are returned at $250,000. This income can be greatly increased by extending the line north and south and the northern extension has already been surveyed to Cuzco, and the southern end can be extended to the Bolivian frontier and towards the famous silver mines of that State which now produce from $15,000,000 to $18,000,000 per annum, a supply which can be trebled by cheaper communication with the coast. Connection, too, could eventually be made with the Trans-Andine system of roads of the Argentine Republic, now rapidly approaching Bolivia from the Atlantic side. Both of the extensions mentioned could be built for about $1,250,000, and it is estimated that they would raise the net income to $600,000.

The second important line is the Southern Railway running from Callao to Cerro de Pasco. When completed this will be the great trunk line of Peru, opening up the best agricultural land and the richest mineral district. From Callao it runs to Lima and thence to Chicla, at the foot of the Andes; 85 miles are now open. In 1886 the gross receipts exceeded $464,000 and the working expenses were about $300,000. The proposed extensions of this road are the heaviest parts of the undertaking contemplated in the GRACE Contract. The main line would be extended from Chicla to Oroya, where it would fork north and south. The northern branch would connect with the silver mines of Cerro de Pasco, and would have to rise in the Andes to a height of 15,500 ft. above sea level. The estimated cost of this extension is $5,900,000. But the southern extension from Oroyo to Huaucayo is estimated by the Peruvain engineers at only $1,750,000.

Cerro de Pasco is only 130 miles from the head of navigation on the Amazon river, and when that gap is bridged over there will be another overland route from the Atlantic to the Pacific bringing Peru into close commercial relations with Brazil.

The promotors of the GRACE concessions, while picturing a brilliant future from the above further extensions, estimate that from the silver mines of Cerro de Pasco they can obtain a traffic worth nearly $3,000,000 per annum gross, with working expenses not exceeding 65 per cent. From the Peruvian Central Railway thus developed they anticipate an annual net income of $785,000. This road and the Southern system are the backbone of the concession now offered by Peru.

Russian Torpedo Boats.

The Russian Minister of Marine has ordered electric search lights with Magin projectors for all torpedo boats. The dynamos and plant for the electric lights are furnished by the firm of Normand & Co. in France, who have also supplied torpedo boats.

The following data concerning the Schichan torpedo boats, ordered in 1885, will be of interest in view of the probable construction of torpedo boats for our navy.

The boats were built for $44,368 each. The launching tubes and torpedo outfits were furnished in Russia. The contract speed was 19 knots which was obtained during the speed trials. The coal capacity is such that they can steam 2,000 miles at 10 knots per hour.

The hulls are built of steel plates ⅛-in. thick. The frames are of steel angle bar 2 ins. × 1.22 ins. × .17 ins. The distance between the frames is 20 ins. The boats are divided into eight water tight compartments by means of athwartship bulkheads, 12-ins. thick.

The dimensions of the boats are as follows:

Displacement with 17 tons of coal	87.5 tons
Draft forward	3 ft. 6 ins.
Draft aft	3 ft. 7 ins.

Upper edge of propeller is 4 ins. below the surface of the water, the lower edge of propeller is 5 ft. 9 ins. below water line.

	FEET
Total length of the boat	138
Length on load water line	126⅝
Greatest beam (above the load line)	15⅝
Beam on the load water line	14⅞
	TONS
Weight of the empty hull	58
" " engines with appurtenances	11.77
" " auxiliary machinery	1.06
" " boilers filled with water	11.6
" " torpedo outfit	2.92
" " artillery outfits	1.2

The torpedo outfit comprises two launching tubes in the bow for steel bronze torpedoes (Whiteheads) which are discharged from the forward coursing tower, which contains two air accumulators, 9.8 ft. long and 8.4 ins. in diam., with torpedo hoisting and transporting arrangements.

Two 57-HOTCHKISS revolving cannon are mounted, one on each side and so arranged that they may be worked from either coursing tower.

The dimensions of the boilers are: Length 14 ft.

4 ins.; width 6 ft. 10 ins.; greatest height, 7 ft. Length of cylindrical portion, 11 ft. diam. 3 ft. 8 ins. Number of fire tubes, 360; external diam. of tubes, 2 ins. internal diam. of tubes 1.5 ins.

The crew consists of 1 captain, 2 junior naval officers, 1 engineer, 1 machinist, 1 coxswain, 1 coxswain seaman, 1 gun-captain, 1 seaman gunner, 1 torpedo petty officer, 1 miner, 1 torpedo machinist, 2 torpedo machinist tenders, 2 machinists, 1 petty officer, 1 sailor, 18 in all. The entire crew, excepting the gun captain, coxswain and seaman gunner, are required to work the torpedoes. The other three men serve the guns.

From "*Morskvi Sborink*," St. Petersburg.

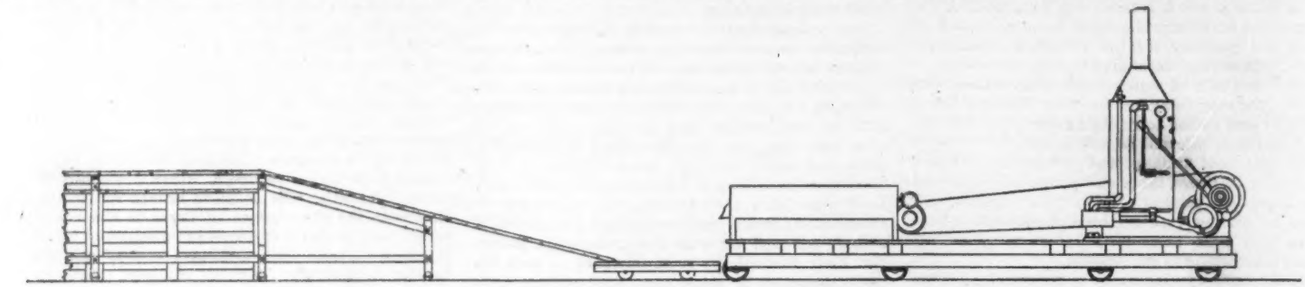
Mixing and Handling Concrete at Ashland Basin No. 4; Boston Water-Works.

The following is an abstract from an excellent paper read before the New England Water-Works Association, June 16, 1887, by Mr. WILBUR F. LEARNED:

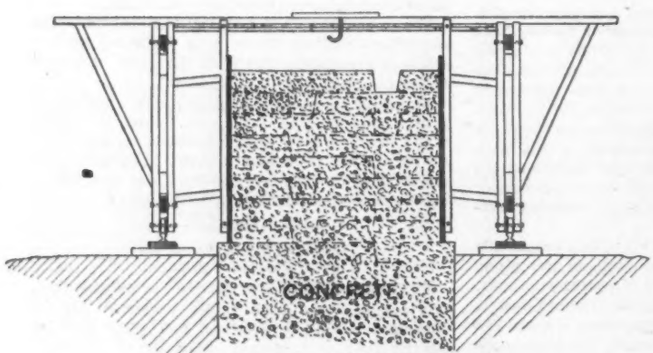
The dam connected with this work was about 1,800 ft. long on top; 51 ft. in height above the meadow, and 83 ft. above the bed-rock. The width on top is 20 ft. and 244 ft. at the level of the meadow. The outside slope is 2½ ft. horizontal to 1 ft. vertical, and it is faced with loam to the depth of 12 in. at right angles to the slope. The inside slope of the dam above the berm is 1½ to 1, and is covered with granite paving 15 in. in depth, laid on broken stone 12 in. deep. The lower slope has an inclination of 1.65 to 1, and is riprapped to a depth of 18 in. with stone so broken that the average would pass through a 6 in. ring. The dam contains 248,000 cu. yds. of material. About two-thirds of this amount was delivered in cars and paid for in car measurement. A measurement on the dam after it was watered and rolled showed a shrinkage of 21.3 per cent.

On the site of the dam the soil was excavated in a trench about 16 ft. deep, extending to the bed-rock. In this a concrete core was built 8 ft. thick, and continued up to nearly the top of the dam and decreasing in thickness by offsets to 3 ft. at the top. The spaces in the trench on both sides of the concrete core were back filled with clay on the water-side and fine sand on the outer side. Above the level of the meadow the material was filled in 8 in. layers, watered and rolled with heavy grooved rollers. Clay was placed against the core on the water side for a thickness of 10 ft. horizontally to the top of the core; outside of this clay fine sand merged into fine gravel and that into coarse gravel. On the down stream side fine sand and gravel were used with sand against the core.

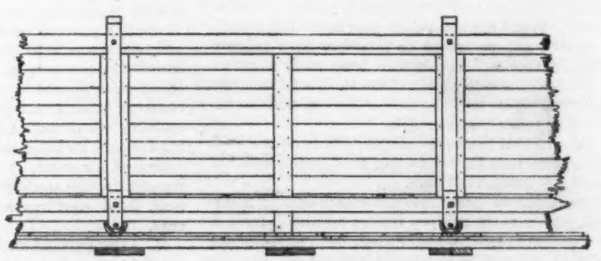
The gravel was dug from a gravel bank about one-half mile from the dam and transported by rail to the dam for 26 cts. per cu. yd. car measurement. The dumping, spreading and rolling the gravel, including moving of the tracks, by city labor, increased the cost to 60 cts. per cu. yd. The gravel was excavated by a steam shovel of 2 cu. yds. capacity, handling on the average 800 cu. yds. per day. The stone used in the concrete and on the lower slope of the dam was broken by a Blake crusher 9×15 in. opening. The largest amount crushed in any one day was 116 cu. yds., measured in place; the average day's work was 80 cu. yds. The cost of crushing was 89 cts. per cu. yd.; the cost of collecting and delivering was $1.09 per cu. yd. The water used on the dam was supplied by a Worthington pump through a 2-in. pipe extending along the foot of the dam and with branch lines connecting with a line laid on the concrete core; this latter pipe was fitted with 2×1 in. tees, 100 ft. apart, for connecting hose.



GENERAL ELEVATION.



CROSS SECTION OF FRAME.



ELEVATION OF FRAME.

Plan Showing Method of Building Concrete Walls.

The mixing and handling of the concrete is described as follows by the author:

The particular brands of cement used on the work were Newark & Rosendale, and Newark Lime and Cement Company's cement.

Each carload of cement as it arrived on the work was tested for tensile strength and for fineness, all casks being rejected that did not show a strength of 40 lbs. per sq. in. after the briquette had remained under water 24 hours or a degree of fineness of more than 10 per cent. as determined by a No. 50 sieve.

All the concrete was mixed in a machine of the pattern made by the Pioneer Iron Works of Brooklyn, N. Y. It consisted of a wrought-iron V shape trough about 8 ft. long on which a shaft was set with arms arranged in such position that they formed spiral lines from end to end of the trough.

An 8 horse power engine ran the mixing machine and both were set on a strong platform.

The cement, sand and broken stone having been deposited on the platform convenient for using, the leader shovelled about 1¼ shovels full of loose cement into the trough—an equivalent to one proportional part in the cask—at the same time a helper standing on the same side of the trough shovelled 2 shovels full of sand and two helpers on the other side of the machine shovelled 2½ shovels full of stone. The revolving shaft with a stream of water graduated to the speed of the engine and the requirements of the amount of concrete in hand stirred the materials into a thorough admixture and forced it in a continuous stream out of the trough into wheelbarrows ready for its disposal. The leader constantly watched the concrete as it passed out of the trough and would add a little more cement or sand when his experience dictated that it was not of the right consistency. Two men with shovels at the spout obstructed the flow of concrete so that a wheelbarrow load could be cut off in one operation. At ordinary speed the machine would keep from 8 to 12 men constantly wheeling away concrete, and at times when the length of wheeling was somewhat long, say from 75 to 100 ft. the larger number of men were quite actively employed.

The quality of the concrete was regulated from time to time by measuring the amount of concrete wall built with a certain number of casks of cement, it having been determined by actual experiment that 1 cask of cement made 22 cu. ft. of concrete when the ingredients were in the proportions of 1, 2 and 5. If it was ascertained that more concrete had been made than was allowed with a certain number of casks of cement, a little more cement was added than formerly and vice versa, if the concrete fell short in amount. In any case the quality was seldom more than 1 or 2 ft. over or under the correct amount.

It was found that the most convenient dimensions of wall to build in one section was 100 ft. in length and 4 ft. in height formed by frames built to the required height and width and connected by longitudinal bracing. The sides consisting of cleated board were adjustable to any required width, and were removed from contact with the wall before moving the forms into a new position.

The concrete was deposited in 6 in. layers and heavily rammed, a groove was formed in each layer on alternate sides by placing the concrete on both sides of a line of timbers of the required form, which were removed before a new layer was commenced.

The end of the section was formed in steps both vertically and horizontally, which, with the grooves of the layers formed a kind of lock for each succeeding section.

After completing a section of wall the sides of the forms were removed; a four fold block and tackle were carried ahead and made fast to an anchor. The rear block was attached to the engine platform and the rope fixed to the drum of the engine; when all were ready

the throttle valve was opened, the drum winding the rope hauled the engine, mixer and forms,—all being connected, - along on a track laid for that purpose.

The old wall where the new section was to be built was then thoroughly swept and washed, the forms adjusted and the water pipe which laid on the wall was hung to the cross pieces of the forms.

The raised pipe was then connected at one end with the pipe on the section already built, and a rubber hose made for the purpose was connected at the other end.

This method of moving the forms as well as the construction of the dam, was under the immediate supervision and direction of Mr. A. E. MARTIN, member of this Association.

The largest amount of concrete made in any one day was nearly 100 cu. yds. or 120 casks of cement. The average amount was not far from 65 cu. yds. or 80 casks.

The cubical contents of the wall was 20,900 cu. yds. comprising 25,650 casks of cement. The average cost of the concrete wall was $4.32 per cu. yd."

In answer to questions Mr. LEARNED said that the concrete stone was made to pass through a 2 in. screen in the proportions of one, two and five; no fine stone was used. The crushing of the stone and cost of collecting it were not included in the cost of the concrete as given. The cost of collecting and crushing the stone was about $1.90 per cu. yd.

The Effect of Temperature upon Structural Iron and Steel.

(*Continued from page 435.*)

DISCUSSION.

MR. RAMSEY: I am like most anybody else, I like to pick my ground. I merely referred to the steel question in one paragraph in my paper. It is a short paragraph, and was simply brought in more to show what had occurred in cold weather with steel rails on our road, than to make it a question at all; in fact, I have left the steel question entirely out of the argument except in that one paragraph. In the first place, iron is more generally used in bridges than steel, and secondly, steel has been made such a study, that they can make it of different and uniform qualities. Steel can be analyzed, and that is one advantage it has over iron. You can analyze steel, and you can get just the kind you want, but you cannot do that with iron.

When it comes to the steel rail question, when a break occurs we require a report to be made on the case complete. I require blanks filled as follows:

1st. Was there any spike maul mark where the break occurred? 2d. Had the ties been moved during the past season? 3d. Had the rail been relaid or was it in its original position? 4th. Was it near a joint? Then to give a diagram, on which they must mark the spot at which the rail broke, a little mark where the rupture occurred. 5th. Was the joint broken? 6th. Was the joint below supported with old ties or new?

All of these matters become of importance, and they lead to a determination of the cause of the breakage of a large number of rails. Still some may have been due to the ballast, the freezing up of the ballast, the bad support of the rail, or something of the kind; or it may be due to the nicking, and I merely offered this as a kind of side issue, not as direct proof of the matter. But I am satisfied to accept your test of taking a steel rail, putting it on equal supports, and then proceed as you suggest, although I think the facts have been proven by Mr. SANBORN, who gives here (pointing to the work from which he had been reading) the results of his experiments. He says that he found with supports of granite blocks, and other conditions equal, except temperature, it required but 25 per cent. of the blows to break at zero as at a higher temperature.

Now I stated in this paper (which is a hurried one, and is but preliminary to other tests that I wish to make, and tests I would like to have others make if they think it worth their while), that the question of steel is one of secondary importance as compared with iron. Of course, you understand that a steel rail is affected by a great many conditions, still I think it can be hardened like other material, and in low temperature such steel will break more easily under a sharp blow than softer steel of more elasticity. So far as I am concerned, however, I am willing to drop the steel question at present.

MR. HUNT: I should like to have emphasized one other point in this discussion, and that is, that all of the tests of the iron which has shown crystalline at low temperature were made from the same material that had been previously tested in the usual way that inspectors make their tests for structural purposes, and it has shown results such as any inspector would have accepted; all of it was from 48,000 to 51,000 and 52,000 lbs. tensile strength, over 28,000 lbs elastic limit per sq. in with 15 per cent. elongation in 8 ins. and reduction of area from 20 per cent. up, in nicking tests, it showed at ordinary temperatures fibrous fractures. In cold bending tests, it over bent a 2 in. round to an angle of 180° without fracture, and generally stood all the requirements of ordinary railroad bridge specifications. Therefore, it is a practical question as to whether specifications as they are now made are all that could be desired, and whether the system we now have is right, or whether we should not have further investigations as to the ductility of ordinary structural iron at low temperatures.

A MEMBER: In looking at this first table, there seems to be a matter that is not clearly brought out. The figures look as if they might be 20° Fahr., and the change shown is very marked; and perhaps lower temperatures than those of Canada might not produce any greater defects in material than those at 32° above or as many below.

MR. RAMSEY: I do not give these as conclusions, but simply as results of some tests which have been made, and as tending to lead others to make tests. I would be very far from giving any conclusions in such a matter on any one or two hundred tests.

The figures to which the gentleman refers are simply the tests of a common range from zero to 32°. There are just half of them in the nick and impact that are below 10° or 15° down to zero, and the other half above. Out of probably 30 tests of that kind, half of them are below 15° and the others above that. Of course I do not exhibit these as conclusive—not by long odds.

I would be sorry to set up my belief as a conclusion. I may believe a thing and still be open to conviction. There are inaccuracies in the paper, and I do not wish to be understood as making a conclusion on any single thing.

In answer to the remarks of Mr. BARNES, that it would be a wonder that bridges and rails and such articles did not go to pieces in view of these tests, I can still allow (him) 15 per cent. of the ultimate strength and be then within your limit of safety. You allow six times over the load that will be carried as a general rule. Why is it allowed? *Simply to overcome what we do not know about iron*; in other words, six times as much as we do know.

MR. BARNES: I dissent very earnestly to that suggestion.

MR. RAMSEY: I intended to state that I do not think bridges any more dangerous on account of my paper than they have been. I do not think we need to be afraid to travel over any of the bridges in our country, especially as we generally allow six times the strain that may come on them.

A MEMBER: The gentleman forgets that rolling stock is now heavier, and this reduces the factor of safety.

MR. BUCHANAN: Mr. RAMSEY has prepared his paper in a very careful manner, in such a manner that it is pretty hard to question his statements. He has said nothing, however, that is particularly new to engineers who have been looking into the matter for several years past—ever since the St. Louis bridge was built. The tests he describes were all made at that time, and prominent engineers have embodied the temperature tests in their specifications for six or seven years to my recollection, and I do not known how much longer.

He says in one part of his remarks that the iron he selected was from the very best quality of iron made by Carnegie Bros., & Co., and I heard a gentleman remark that that was pretty hard on Carnegie Bros. My understanding was that he took any iron that Carnegie Bros. were rolling at the time.

In my tests I took iron that had been rolled on orders for refined bar iron, double rolled. The iron he took was nothing but round; commercial round, and was only single rolled iron. I made some twenty tests, the principal being in trying to break the iron as rapidly as possible in the tension tests. I made tests varying in duration from four seconds to 1 m. 58 sec. I wanted to ascertain whether there was any possible variation in the results produced by breaking the specimens quickly.

I tried to break them just as quickly as I could, getting the load on and adding to it, but not so as to get an impact load. I could not find in any of the tests I made that there was any difference at all in the elongation, in the reduction or in the character of the fracture, no matter what the time of test was or the temperature at which it was made. But in making these quick tests I got one difference in results from Mr. RAMSEY, and that was, that the specimen when it broke was still cold, while in the tests he made, making the time 7 to 10 minutes, when he took and broke them the fracture was always warm, due to the heating of the metal by the flowing.

In these tests, as I say, the temperature was still low when the specimen broke. The fracture was in all cases a clean fibrous one, and the reduction and elongation good. Then I took from one of the bars that had been rolled two pieces 18 ins. long. From these two pieces I cut from the side a test piece which was turned down for making the tension test, and with the remaining part I made a nicking test, so that these tests were all made in duplicate. Specimen marked "1—A" was made at low temperature, both for tension and nicking test. Those marked "B" were made at normal temperature, which was about 80° at the time tests were made. In the nicking tests we got a variety of results. Some of them were perfectly fibrous, both at low temperature and at normal. In one case there was 95 per cent. crystalline appearance in the fracture, and, what I thought was significent at the time, I found the specimen contained 3.08 % phosphorus. One that broke fibrous at both temperatures had 1.53 per cent. phosphorus. Then there was another specimen that broke with 55 per cent. crystalline structure that showed 2.89 per cent. phosphorus. Then others had very little crystalline appearance in the fracture, some down as low as 15, 7, 5, 10 and 25 per cent.

MR. ROBERTS: I have a little "impromptu" address to read on this question. The reason I want to read my paper now is for fear somebody will say it before I can get a chance. [Unfortunately, we have not the copy for MR. ROBERT'S address.—ED.]

MR. KOCH: I will be very happy to continue this discussion, but it compels me to go back many years, for it is a long time since I had anything to do with iron, probably 15 years. It was in the early days of steel and we were suffering terribly from the attacks of the iron men and there was considerable discussion on the structure of iron and steel.

I remember one experiment that may throw a little light on this question. You know the climate of England is peculiar. In the winter season during a rain storm it as likely as not to turn cold suddenly so that you will not have time to get your umbrella down before it is frozen stiff. I have seen vehicles standing in the streets of London from which the horses have been taken and the people obliged to walk home, the wheels having become fastened so tightly in the frozen ground as to be unable to be dragged out, and I remember once skating all the way down Oxford street on such an occasion.

Well, now, when that happens it plays the very mischief with iron structures, especially if unpainted, and we made some very curious experiments. We got some good fibrous iron bars, unpainted, and put them in salt water. Then we took them out and gave them a good washing, and then left them in fresh water and then we froze them and finally on investigation it was found that the iron by this process had lost its roundness. And what made it happen? Iron being fibrous and there being room between the fibers, not being a homogeneous material, like steel, the water penetrated between the fibers and being frozen there it had the effect of changing the condition of the bar so far as its shape was concerned. We put the bar in the microscope and after being treated in this way, we could see the interstices.

To make the experiment more exact we took hyposulphide of soda, and we treated the iron with this solution. The iron was left there for about six or seven months, all together, and then it was taken out and sliced, and then used the polariscope and we were astonished at the result—to see the effect produced by this treatment. You would be astonished to see how perfectly susceptible iron is to absorb materials in solutions of this kind. This can be remedied to a large extent, however, in the case of structural materials, as well as others, by keeping them well painted.

In the matter of steel, we did not make as good steel 15 years ago as we do now. We were very unhappy to find that we got some very crystalline structures in steel. I have tried it since, however, and am glad to say we have improved so far that I do not get any such crystalline structures. But I think the question of crystalline and fibrous structures is not so very difficult as people imagine because you can see the same thing in ice. I remember Prof. TYNDALL showing me on one occasion a piece of ice that had a chrystalline structure in one place and a fiber in another. When I asked him how he accounted for it, he replied that he could not account for it.

However, the result of our experiments, the absorption of water by iron and its freezing may account for some of the things which we are now unable to explain.

Prof. PHILLIPS: It seems to me in this connection it might be said that, *a priori*, we could conclude that changes of temperature would have some such effect as stated on iron. There are so many cases well known where slight changes of temperature have produced great changes in qualities of things and it might almost be considered to be the exception to find this not to be the case. I may mention a few of these.

We might cite, for instance, arsenic. Metallic arsenic condenses in two perfectly distinct forms, one a soft black powder; the other is a hard brittle crystalline substance, intensely hard, difficult to break in a mortar.

The metal antimony is another. I have two beautiful specimens one silver white, not at all like the commercial antimony, and the other is a dark lava-bronze metal. These are the natural surfaces and are very brilliantly lustrous. These two metals have different modifications for different metallic conditions and different physical properties. They are quite different, especially in the matter of brittleness.

The same thing is true of carbon, as everybody knows.

By heating, the diamond is converted into substance like coke. Heat causes the most wonderful change in the hardness and brittleness of metals. The metal zinc is subject to such changes as these. You know that zinc can only be rolled at something over the boiling point of water.

Now there are many cases like the foregoing. Lime water is a crystalline liquid like calcide and its crystalline deposits are totally different minerally and in brittleness although having the same chemical composition.

In every one of these cases there is a most extraordinary difference in the tenacity and brittleness. Now it was stated at the last meeting that this property of iron of varying under very slight conditions, of changes in temperature, if true, would cause railroad bridges to break down and that iron when tested for chemical properties should show this condition. Is it not possible that the piece of iron exposed in this way to a very low temperature might undergo this change, getting more brittle? Of course as an allowance has been made, as was suggested then, for a possible break down of the structure, there is no danger, but if this same iron were tested again, say at the same temperature that was used before the change in structure had occurred, would it not lose its brittleness, or to use a common expression, regain its former strength? In that way this property might have been overlooked if it really exists. As it appears that the quality of brittleness is common to a large number of bodies we are very likely to find that same property, in greater or less degree, among a great number of metals.

MR. BRASHEAR. I have made a great many studies of iron, and its breaking under strain, and I wish to speak about something that is well known to most opticians and to those who have made a critical study of the condition of glass, and I think we can see in the glass that some of the conditions existing there may be borne out in the case of iron and steel, or any substance of a corresponding structure.

When an optician takes hold of a piece of glass to work it into a lens the remark comes to him that so many people have made. How can you work it? Did not they break a lens of the great Lick telescope? Yes, but they knew they were going to break it before they commenced it, and they took the piece of glass under protest because ALVIN CLARK was able to see right through it. It would be an unfortunate thing for an optician if he had to work his material first, and then expect results afterwards. He must know his conditions, he must know his material, know just what he has to work on.

I wish we could see through iron as through glass, but I think we can see co-relation there, and I am of the opinion that if we want to investigate nature we must get right down to nature's methods. If you please, we must commence down with the molecules.

A glass manufacturer said to me one day; "I wish I could tell when my glass is perfectly annealed." "Well," said I, "you can see when it is perfectly annealed." "Oh," said he, "there is no man living can tell this. We take a piece of glass and we put it away thinking it is perfectly annealed, and when we go to get it to use it we find it cracked and broken. "Well," said I, "we will see. Suppose you come up to my house this evening." This same gentleman had made me a present of a very nice set of glassware. When he came I took these pieces and put them under the polariscope, and when he got to examining them I never saw any one more astonished in my life. I proved to him from the polariscope which pieces were perfectly and which imperfectly annealed, and then I explained the matter to him. "Why," said he "that will save me $5.000 per year. For instance, "said he, "we select a dozen pitchers that we think are annealed perfectly, and put them away after the work of engraving. When we go to get them we find our glass is shivered to pieces. If I could see that I would know which pitcher to anneal and which to sell unannealed." "Well," said I, "all you have to do is to get a polariscope."

Now, what is annealing, the common sense meaning? There are substances in nature which can be used for lenses that have been formed for thousands of years. We find that they are annealed in every atom, perfectly, and we can with the greatest assurance make lenses out of them, but with our glass we are not sure of the annealing.

Now we make our iron and steel and finish them for structural work. It seems to me that the conditions are largely the same in these substances as in glass or any other crystalline substance; that is, if the substance has been colored or heated in such a way that the atoms do not have time to assume a normal condition, that the result of any sudden strain will be a rupture, and I have no doubt that will be found the reason in many instances why the material will break, if of a crystalline structure. I wish we could find a polariscope that would act for iron as the one we now have works for glass, that we could see into iron. If you take any substance such as iron or glass, and heat it to any considerable extent, and then cool it off rapidly there will be produced such a change in the construction, it will be subjected to such an enormous strain, that the danger of breaking is greatly increased.

I was one time working a little piece of glass that weighed about 50 lbs. I put it under the polariscope and I discovered there was a strain on it. I noticed, however, a little projection sticking up on it and I took a hammer and merely touched it, thinking to smooth it down, when the glass flew into a thousand pieces and almost frightened the life out of me. I have had this occur several times in the same way.

Now as iron and glass are largely of the same structure the same conditions that would affect the one will, to a greater or less extent, affect the other. We find that glass itself has a sort of a fibrous structure something like rolled sheet iron.

(TO BE CONTINUED.)

The Water-Works of Kansas City.

BY G. W. PEARSONS, CHF. ENG. NATIONAL W. W. CO.

Concluded from page 437.

Flow in Long Lines of Pipe. (Plate 11.)—The original of this diagram was given in *Transactions* of the American Society of Civil Engineers for Feb., 1876. Further data from large pipes shows the quantities there given too small. This is corrected from the writer's tests of 24-in. pipe; the 48-in. pipe of the Glasgow aqueduct, and the Croton aqueduct. It is not probable that any data can be had covering the irregularity in size and condition of pipe; the writer believes this to be nearer correct than any other with which he is acquainted.

Pipe and Pipe Laying.—The pressures ranging from 40 to 200 lbs., and the lines being at all times subject to the action of elevators, locomotives supply, etc., without the relief of reservoir or other gravity maximum, gives rise to shocks of unknown amount, but in all probability greater than the average of most cities.

In two instances where the machinery was working at very high speed, with a pressure of 200 lbs. per sq. in., its action was suddenly arrested, once by closing four 1¼-in. streams together as quickly as possible; the other time by the accidental closing of a 20-in. hydraulic valve. In both these instances pipes were burst which had stood pressures of 240 lbs. per sq. in., and the pipes were of fair quality, these are the only instances where pipes have given way that did not show marked defects. The pipe being tested to 200 lbs. and upwards, in the ground, results in bursting such as are very defective. Great care is used in inspection before laying, and the loss has not been more than an average of one pipe in 10 miles. Leaks from imperfect caulking have been as infrequent; these tests are made before the pipe is placed in service, and though numerous leaks and breaks have occurred from pipe being laid in made-ground, from contiguous sewer excavation, etc., there has never been a failure disabling the works from giving fire protection.

In all the cases of pipe broken in the ground, the writer cannot recall an instance where the pipe was not thicker on one side than on the other, and in most instances the difference was considerable. One 16-in. pipe which burst in 1886, was $\frac{7}{16}$ths thick on one side and $\frac{3}{8}$ths on the other. The iron was very porous and spongy. Other cases have been as extreme.

It is difficult to believe that such pipe which is carefully examined before laying, is apparently as perfect as any in the line, and which fails with pressures below 100 lbs., have ever been subjected to hammer test under 300 lbs. pressure. We know that such omissions occur in other work, and while it is the interest of the pipe manufacturers to guard against them, and they should not be too hastily blamed for such failures which at most amount to a very small percentage, still the gravity of the result of such breakages would justify a reasonable amount of care to guard against them.

This uneveness of thickness is a matter of more importance than seems to be generally considered: the quality of iron is of less consequence; so long as it is free from impurities that tend to porosity, there is probably little that need be rejected on the score of strength, with the thickness generally used. This unevenness of thickness is generally in the center of the pipe, cause probably obscure; it may be that a stoppage of flow of iron on one side, by heating the core unevenly during the pouring, causes it to spring. Whatever the cause, it introduces an element of weakness not only by the shell being thinner than supposed, but by difference in strains caused by unequal cooling, which may result in failure after it has passed test and been put to use.

The care bestowed on some pipe by agents of the purchasers causing it to be callipered to ascertain such variation in thickness, does not apply to the far greater amount which has no such inspection.

The writer would suggest that if the pipe could be rolled a short distance over level skids, by a single person, any serious variation in thickness would show itself by the heavier side retarding or accelerating its motion, this, if made before the tar bath and test, would save these in rejected pipe.

The thickness of pipe used at Kansas City has been from $\frac{7}{16}$ for 4 ins. to $\frac{13}{16}$ for 20 ins., and these pipes have stood the heaviest pressures used, so far as can be known, equally well with heavier ones. (We have not always obtained pipe as light as called for.) An annoying variation exists in the size of pipe bowls and spigots from different manufacturers. The care taken to keep uniform interior diameters, looks like caring for decimals at the expense of integers. The increment in the size of bore is from 1 in. in the smaller pipe to 2 or 3 in. in the medium size, and more in the larger. With these differences it would seem as if a uniform scale of sizes of bowls and spigots might be adopted by the different manufacturers, leaving differences of thickness to affect the bore of the pipe.

At most water-works, the supply of pipe is drawn from various sources, and an amount of trouble is made for the pipe layers by these differences that is not always appreciated at the offices. The breakage of one pipe in 10 miles, before spoken of, refers to about 70 miles of pipe laid since the building of the works. Although in that, some 5 miles which have been laid under our personal supervision, did not show a leak or break, neither does it include the pipes which are rejected on inspection before laying; simply shows how nearly such faults may be eliminated by the constant care of experienced men.

A practice in the West is to put several pipes together on the ground and make the joints before lowering them into the ditch, it saves a little in breadth of trench required, and is supposed to be a fast way. The writer has seen considerable of this but has never seen or heard of any good work done in this way. Our practice is to bed each pipe separately and make ample bowl holes, tamping carefully under the pipe and filling the trench with shovels. The labor of tamping is never made less than that of shoveling back. We sometimes puddle or fill loosely on ungraded outlying streets, but never on paved streets, and do not have to do our work twice. Our rule for lead is 1⅛ ins., or to the back of the lead bead. All plugs are anchored by cast-iron clamps and wedges; the concussions before spoken of have blown some of them out.

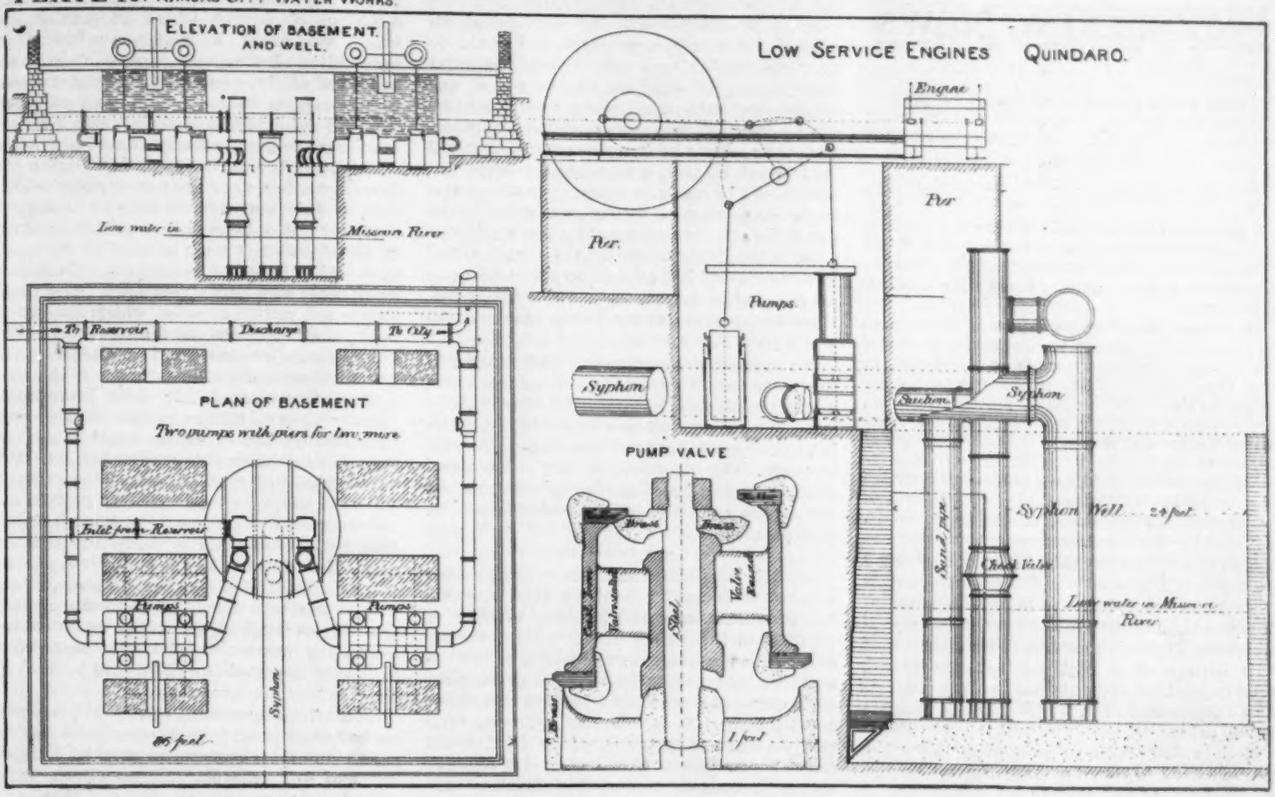
With regard to water ram in pipes the writer considers that it is not particularly affected by pressure, and should be considered as an increment and not a percentage, the allowance of 100 lbs. per sq. in. may sometimes be none too much at the ends of small mains, but the writer has never seen such an effect anywhere away from these ends.

In conclusion the writer has endeavored to make such suggestions as personal experience seemed to require, and in the description of these works to give such items as would be most likely to be new. The practice of yearly reports as by municipal bodies is not usual with private corporations, and it is but seldom that the opportunity to return their courtesies is available.

THE annual report of the New York Arcade Railroad Company, to the State Railroad Commission, shows cost of road and equipment to date, $398,458,90 and cash on hand, $1.10. The total expenditures to Sept. 30, under the same head, were $366,064.28.

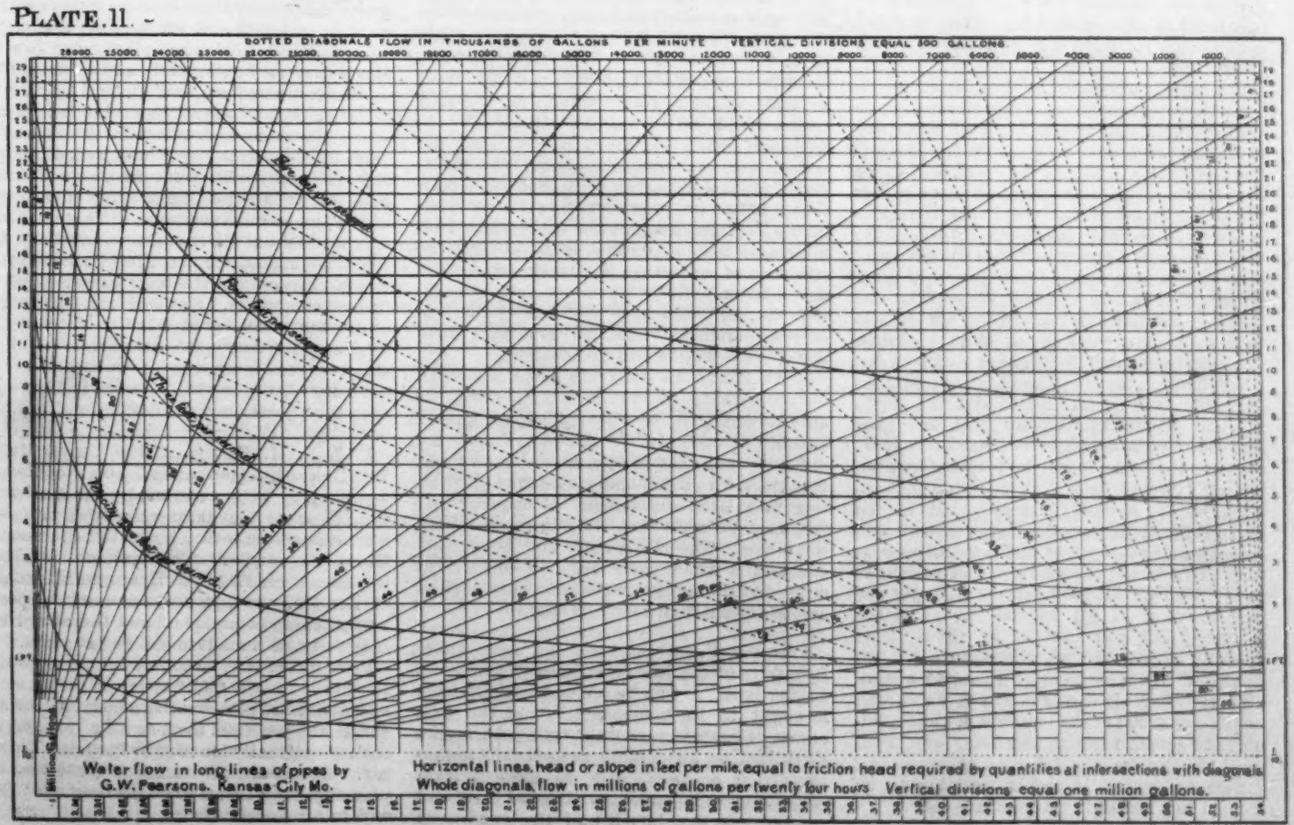
THE scheme of the Pennsylvania Railroad Company for the establishment of an employés' savings institution has been perfected, and on Dec. 20, President ROBERTS issued a circular outlining the plan. Any employé may deposit with any freight or ticket agent designated to receive the same, any sum of even dollars not exceeding $100 in any one month. Until further order of the Board of Directors, interest at the rate of 4 per centum per annum will be allowed. Depositors desiring to withdraw will be required to give ten days' notice.

PLATE 10. KANSAS CITY WATER WORKS.



Kansas City Water-Works; Low Service Engines.

PLATE 11.


DOTTED DIAGONALS FLOW IN THOUSANDS OF GALLONS PER MINUTE VERTICAL DIVISIONS EQUAL 500 GALLONS
The Mississippi River at St. Louis
Four Feet per mile
Two Feet per mile
One Foot per mile
Water flow in long lines of pipes by G.W. Pearsons. Kansas City Mo.
Horizontal lines, head or slope in feet per mile, equal to friction head required by quantities at intersections with diagonals. Whole diagonals, flow in millions of gallons per twenty four hours Verfical divisions equal one million gallons.

Kansas City Water-Works Flow of Water in Long Pipes.

ENGINEERING NEWS

TRIBUNE BUILDING, NEW YORK.

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D. McN. STAUFFER. A. M. WELLINGTON. EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

THE stand taken by Gen. NEWTON that good pavement in this city is not possible unless very much more attention is paid to its maintenance than in the past, is a most commendable one. The only comment to be made is that this feature of careful maintenance is one long recognized and enforced in every English and Continental city, where good pavements really exist.

Here in New York, in years past, the practice has been to spend a large amount on the original paving and then to let it take care of itself for a term of years, with public and private corporations digging, meanwhile, into its foundations at their own sweet will. When the surface became too much furrowed by the sinking of trenches for water, gas and divers other conduits, a new pavement was in order.

The remedy suggested by Gen. NEWTON is to prohibit any disturbance of the streets by private corporations, and to have all necessary excavation and repaving done by the Department of Public Works at the expense of these corporations. In this progressive, or rather transition stage of our municipal life, this seems to be the only check possible upon the continuance of a crying evil, and the only way open to the securing of even passably good streets. Until a future generation sees the wisdom of providing sub-ways to contain all that belongs underground in our main highway, (underground passages in which workmen can relay, inspect, make connections, etc., without disturbing the surface above and the traffic upon it) we suppose trenches must be opened and new work done, or old works undone. Further than this, it will be long before even the rich city of New York could afford subways on its secondary streets; but in the meanwhile all the work done upon them should be only under competent and responsible control. This is not the case now and never has been. The private corporations have but one end in view as far as the city pavement is concerned, and that is to rip it up as speedily as possible, lay their pipes and fill the hole. What happens to the street a week after they leave it is no concern of theirs; the public can growl at the long ditches and puddles and splash through and bump over them until the city feels called upon to lay a new pavement, which is sooner or later to be treated in a similarly ruthless manner.

The advantages of Gen. NEWTON's plan are many. The work would be done more leisurely and by experienced men subject to Department discipline and the supervision of experts. The controlling powers would have no interest in common with the economical directors of a private corporation, and would be only responsible to a patient, but somewhat exacting public—exacting as soon as it was taught how such work could and should be done. While it is perhaps practically impossible to so relay a broken pavement that it will be as good as new, a vast improvement can and should be made on present practice. And if the cost were in better proportion to the quality of the work the public has a right to expect, the corporations would perhaps find that they could just as well do without four or six gas mains, for example, down one street, when two would answer every practical demand from consumers.

We trust that Gen. NEWTON will succeed in the inauguration of his new methods of control; and if he succeeds, as he should, New York, in time, can have pavements that will not make it a shame among great cities, as is at present the case. Our Broadway to-day is in a state that would disgrace any country town; and we can expect little else under a continuance of past practice.

THE late derailment and narrow escape from a worse accident on the New York elevated has provoked an entirely unfair amount of criticism in the public press, the conductors of which, as a rule, know nothing of the immense difficulties of handling its enormous traffic, or any other traffic, without occasional accidents, and hence cannot appreciate the really admirable skill with which the elevated traffic is conducted. Considering how entirely without precedent was such a traffic, so that the art of handling it safely had to be gained by experience rather than gathered from past practice, it is very remarkable that the work of all departments should have gone on so smoothly and safely as it has.

This is especially true of trackwork. Rails must be renewed, and frogs and switches must be renewed still oftener, and this must be done under a traffic which, on ordinary roads, would be considered as absolutely prohibiting track-laying work. Even at night the trains run but 15 minutes apart, but the difficulties of night work are so great that it has been found better in practice to do all track-work in the daylight hours, even with trains running only 2 to 8 minutes apart. Under the stimulus of necessity the track force have developed a skill which is not only remarkable to the uninitiated but likewise to the most experienced trackmen, and they have never heretofore caused an accident.

Nevertheless, as accidents must occur and do occur, even in ordinary track-work, we may be sure that the elevated cannot forever entirely escape. In the late derailment the difficulty was that the trackman was caught by a train with a rail badly spiked, while putting in a frog, and instead of flagging and stopping the train took the chance of letting it go over. The rail spread, but the wooden guard-rails which have been so effective in other derailments prevented any more serious results in this than a general scare.

THIS is well, but the long and remarkable immunity of the line has an element of great danger in it. It will be remembered—at least it ought to be remembered—that the first eleven or twelve years of the railroad era were signalized by an equally remarkable immunity from accident, and we suspect from largely the same cause, partly good luck, and partly that the novelty of the conditions brought about a general and incessant caution in every employé, which custom at last dulled. The elevated is now tempting Providence in one way at least, by putting in a large number of new frogs and switches, every one of them a source of danger which no caution can wholly eliminate. It is also true that they have miles of structure with a very small margin of safety, especially on Third Avenue, which ought to be renewed altogether instead of being patched and tinkered out of all resemblance to good engineering work. Some of this patching work, as notably that in the immediate vicinity of the late derailment is of such bad design, that we have no hesitation in saying it should on no account be permitted in the streets, not only because of its weakness, which is reason enough, but because of its slovenly and ugly appearance. The Chatham Street station likewise, which does about 10 per cent. of the whole business of the elevated lines, is so contracted in dimensions as to be a source of positive danger in the rush hours. These or other less preventable causes will in all human probability yet cause some abrupt and shocking break in the elevated's most honorable record; but even if it does, it must in fairness be remembered that it will take a very severe accident indeed, and one from clearly preventable causes, to justly balance the favorable presumption from the past. Certainly the late derailment is not calculated to diminish this presumption, except for the one fact that it arose from the insertion of *new* frogs in the track, which we are not by any means clear should be regarded as necessary or permissible additions to it.

A SOMEWHAT interesting question, both from an engineering and legal standpoint, is the proper and most economical method of figuring areas of irregular cross-sections, when these are very great in number, and the saving of time and labor is a quantity worthy of consideration. The final estimates of the New Croton Aqueduct tunnel will answer for an example where over 15,000 of these cross-sections must be carefully and yet speedily measured.

On railroad work the planimeter can be and is used very extensively and successfully, on intricate sections, and much labor saved thereby. But we should be glad to hear of the use of the same instrument in the measurement of cross-sections of less area, in which any inaccuracy will count faster in dollars, than if it were a question of a few square feet of land or embankment only. There is probably no doubt at all, that areas plotted by this little instrument, are much less liable to error in total areas, than the most careful work of trained computers. But it would be interesting to the profession at large, to know of any case where it has been extensively used on small areas of large values; and whether the accuracy of the results obtained have ever even been questioned in the courts of law.

Prof. L. M. HAUPT, of the University of Penn., has had the unusual honor conferred upon him of being awarded, by the American Philosophical Society, the Magellan premium for his paper on the "Physical Phenomena of Harbor Entrances." This premium, or medal, was set aside in 1786 by J. HYACINTH MAGELLAN, of London, "to encourage the arts of peace and promote commerce," and the award has only twice been made in the last 45 years.

Prof. HAUPT is to be congratulated upon this recognition of the many merits of his paper by so learned and conservative a body, of both scientific and practical men, as form this ancient society, originally founded by BENJAMIN FRANKLIN. The awarding committee state that the plan suggested seems to be the only one "that will fulfill the conflicting conditions" present in the Philadelphia harbor. We have already had something to say on the project of Prof. HAUPT and expect later to give the matter more fully.

As is proved by our correspondence in the present number, the question of reform in the adminstration of our public works is a very live issue. We have lately given our views on this subject and expect to more fully treat the matter in the near future. For the present we can only say that no good but much evil can result from making a class issue of this controversy. The intelligent and thinking men among army as well as civil engineers fully recognize the evils of the present system, and any thorough and practicable reform that will do justice to all engineers and the public as well, in the planning and execution of public works, will doubtless meet with hearty co-operation.

We would go further than the intimation given in Mr. COOLEY'S letter, and put all control, not in a bureau, but in a National Department of Public Works, presided over by a new cabinet officer. This officer should combine in one department all the work now divided up between the Secretaries of War and the Navy, the Treasury Department, the Postmaster General, etc.; and were this done, as it should be, it is hardly necessary to remark that the new officer would become one of the most important in the Cabinet, second in fact to none in the magnitude of works under his control. Wars occupy little of our attention and proportionately cost us little money, and yet we have two cabinet officers to preside over our warlike affairs, such as they are; while the arts of peace and commercial and national advance are unrepresented in this cabinet by any special officer, and their control is spread among those who are officially supposed to have something else to attend to. This status is not only ridiculous but it is very unbusinesslike and calls loudly for reform, and with many others we hope to see the matter speedily taken up in Congress and intelligently discussed and vigorously pushed to a definite and satisfactory end.

THERE is one use for a fraction of our overgrown surplus which we are sorry to see does not attract much attention from the press, but which would probably meet with universal approval if inaugurated, viz: to take a national census every five years instead of every ten years. It is a very serious annoyance to those who have to study a multitude of economic and technical problems, that they must rely for a full half of every decade on statistics which are so far outgrown as to make them more deceptive than wild guesses for many purposes. It is in many ways a public misfortune that this should be so. The world moves so fast now-a-days, on this side of the water at least, that statistics more than five years old are of little worth, while the cost of taking a census is so small a sum, say one-tenth to one-fifteenth of a cent for each inhabitant, that it is not entitled to appreciable consideration.

Another advantage of taking quinquennial censuses would be that it would enable the census work to be carried on by a permanent trained staff, since it takes about five years to complete a census properly, whereas now the organization is for the most part completely broken up by the time the decennial year comes around, and has to be formed anew of green men. The advantage which would result from the increased efficiency which practice gives is obvious. Gen. FRANCIS A. WALKER made a strong effort to have quinquennial censuses inaugurated in 1875, preparatory to the centennial year, and came near succeeding. It will need but little effort to have the plan adopted, and the legislation to that effect might well be incorporated in that needed for the coming census. Otherwise, it might be an inappropriate time to speak of an intermediate census when the date of the regular one is approaching.

THE letter from the Chief Signal Officer of the United States which appears in another column will, we are sure, be read with interest and satisfaction by all engineers interested in hydraulic and sewerage works. Gen. GREELY has in all his conduct of the Signal office shown an intelligent interest in making it as useful as possible and in avoiding that natural tendency in all great public offices,—sinking into a routine, and neglecting chances to enlarge or improve upon past methods.

The modest appropriation of $2,000 to $3,000 which he proposes for self-registering rain-guages, shows how much may be accomplished by a very small sum of money, for it is to be remembered that these instruments, once bought, serve for an indefinite number of years, and the observers are all at hand without extra cost. We hope that every reader who may have opportunity will do all he can to ensure this slight appropriation going through, remembering that even the most worthy appropriations often fail for lack of a word of explanation to the powers that be, our sapient Congressmen.

A chief purpose to be subserved by such a record is not merely, how often does the *maximum* rain-fall occur at each point, for that is an event which only occurs once or twice in a century. The great desideratum is:—How often do the heaviest rain-falls of various rates occur, from ¼ in. per hour to 2 in. in every year or decade, and for how long a maximum and average time does such a rain-fall continue? The records from which such laws are deduced, must necesarily be somewhat voluminous, and yet by proper study, aided by records of say, ten years, a very close approximation to the real probabilities could be obtained, and drawn graphically on charts which would be of the greatest aid to hydraulic and city engineers; and even without this, the bare records would give to a man who might be designing works at special points material for digging out for himself some approach to a law, where now all is guess-work, and often very bad guess-work. We make space for a part of the October review referred to by Gen. GREELY, and hope hereafter to be able to give more, but it will be a great satisfaction to engineers merely to know that the material exists when wanted.

By General Order No. 76, issued by the Signal Office of the War Department under date of Dec. 13, 1887, the attention of observers is especially directed to determining as accurately as possible the rate per hour of excessive rainfall at signal service stations. In lieu of any definite scale, the "excessive" rate has been fixed at 1 in. per hour and 2½ ins. per day of 24 hours. As the service is not yet provided with self-registering rain-gauges, the time of beginning and duration of all violent rains are to be noted, and the rainfall measured.

This order is in accordance with the letter of Gen. GREELY, elsewhere given, and the thanks of engineers generally are due to this official for his quick appreciation of their needs, and the invaluable data which will thus be placed at their disposal.

THE reception given by Col. JULIUS W. ADAMS, Ex-President of the American Society of Civil Engineers, to the retiring President, Mr. WM. E. WORTHEN, on Thursday evening of last week, was a most enjoyable and in a measure significant event, as indicating the increasing "solidarity" of the Society, and as inaugurating what may become a custom, and would certainly be a very good one, that of an annual reception or some other social event of a similar nature to each retiring President, at least when he belongs to the old stock, the fathers of the profession in this country, of whom so few now remain that there cannot be many more to whom such a courtesy can be tendered.

Both Col. ADAMS and Mr. WORTHEN belong to this old stock, and the assembly was notable for bringing together four men at least who were all among the original founders of the Society, as well as of American engineering, viz., Gen. GEO. S. GREENE, aged 86, Col. ADAMS, aged 75, JAS. B. FRANCIS, aged 74, and Mr. WORTHEN, aged 72, all of them seemingly still in the full vigor of life, but certainly past that age when they can in the nature of things be expected to meet many times more together. It was therefore gratifying to all present that Mr. and Mrs. FRANCIS should have been able and willing to come on from Lowell especially to attend the reception, but we trust that we violate no confidence in saying that it may have been merely a result of old habits of discipline, Mr. FRANCIS having done almost his first professional work as rodman for Col. ADAMS. We risk nothing in surmising that there are few others left of Col. ADAMS rodmen of that date who could have been similarly impressed into service, and certainly none who would have been more cordially welcome.

A VERY ridiculous invention has been brought out with something of a flourish of trumpets in Boston by the Swinerton Locomotive Driving Co. again showing the invincible gullibility of mankind about mechanical frauds. From the glowing description of a Boston paper, almost every word of which is a no-such-thing, we extract the following to illustrate the scope of this promising novelty:

"The Swinerton Locomotive Driving Company steps in and offers railroad companies a preventive for slipping drivers, and also a locomotive so constructed that it can be run around sharp curves and up steep grades at the same rate of speed at which it is run down grade or on a level track. To the inventor it occurred that first and foremost a driving wheel that would get a better grip upon the road must be found, and he invented a wheel on a different basis from *the old circular wheel* ("the old circular wheel" is good. ED.)—that is, he built a wheel for a driver polygonal in shape. To be more explicit, he cut in upon the steel tires of his drivers 105 facets, 2 ins. long. It will be readily understood from this that his steel-tired wheel *will always have two inches of surface lying flat on the rail* (Oh, certainly. ED.) a considerable space more than that heretofore covered by that mathematical line. This gives the driving-wheel the grip that up to this time has been lacking.

"The facets, of course, cannot be distinguished on the cut. Indeed, without a level it would be impossible to notice them upon the machine itself. Of course, if they were that size and proportion—rough-edged, so to speak—the driving wheels in their revolutions would "thump the rail" to such an extent as to tear up the best track ever laid.

"The advantages claimed for this machine are, first, that it gets greater traction, the locomotive being thereby enabled to haul from five to eight cars more of freight than would an engine of the same capacity that was not provided with the new style of driver; also, this new locomotive, with its greater traction, will go up grade just as rapidly as it will go down grade, *because the wheels will not and cannot slip.*"

There are quite a lot of other details equally nonsensical, but this is enough. The Swinerton company have succeeded in getting quite a lot of good names connected with them however, and in getting Mr. H. S. KOLSETH, Master Mechanic of the Boston & Lowell Railroad, to take charge of the construction of the engine. Mr. KOLSETH had better be in better business.

MESSRS. SULLIVAN, RIDER & DOUGHERTY were awarded the contract for the Sodom dam, on Dec. 19, by the New Croton Aqueduct Commissioners for $806,490, the lowest of 17 bids running from that figure up to $584,315.

The "Lowest Responsible Bid."

The award of the Harvard bridge across the Charles river in Boston to a local firm, in the face of two lower bids from responsible parties, has naturally caused some dissatisfaction. The bridge commissioners, in making this award, frankly state their reasons as follows:

That in consideration of the distance of the works of the lowest bidder, the King Iron Bridge Co., from the City of Boston, and the necessary expense of keeping an inspector at Cleveland, O., for the inspection of the work as it progresses, and in lieu of the many advantages that would result to the cities of Boston and Cambridge, and their manufacturing and industrial interests by having the work done in this immediate vicinity, and under the personal supervision of our own engineer, and other economic reasons, it is deemed for the best interests of the work that the bid of the Boston Bridge Co. be and is hereby accepted.

The bids of the various firms, including the best in this country, were given in our last issue; and it is there seen that the Keystone Bridge Co. of Pittsburg, Pa., was also lower than the Boston firm, and the bid of the Union Bridge Co., of New York was only $80 above the successful bidder in the first item of over $160,000, and only $\frac{1}{20}$ of a cent per pound above it in the second item. The fortunate firm is one of excellent repute, and is doing perhaps the bulk of similar work in the New England States. And it is understood that the Commission distinctly stated that it had nothing but the highest respect for the two rejected firms referred to, and that the reasons given, alone influenced them in making their award as they did.

From a purely local standpoint the wisdom of the Commissioners' decision cannot be questioned. Good work is assured, and they had abundant data in the number and standing of outside bids to prove to them that they were only paying a reasonable price for the work, and the excess of price over the two lower foreign bidders would be distributed among their own people. Unlike either of the cities, represented on the Commission by Mayor O'BRIEN, of Boston, and Mayor RUSSELL and Mr. LEANDER GREELY, of Cambridge, they were *not* compelled to accept the lowest responsible bidder, regardless of location, who could present a satisfactory bond. This Commission was a special one appointed by the Massachusetts Legislature and empowered to act in accordance with a majority vote without regard to city ordinances. And as these gentlemen could have no interests other than what they consider best for the cities they severally represented, the honesty of their award cannot be for a moment questioned.

But in giving the work under the conditions named to a home firm they, perhaps unintentionally, did harm to every outside bidder in failing to give public caution in their invitation for proposals that a preference for home industry was intended, other things being equal or nearly so. Such a caution would only have been fair, and its insertion in the original call would have avoided all occasion for bitterness of feeling. It is a common practice in government advertising for proposals, and it was particularly stated in the call for bids for the construction of our new cruisers for the Pacific coast, that, other things being equal, the ship builders on that coast would be preferred. Of course, in any such preference, the quality of the work and an equitable equality in the bids is duly considered. There is no possible objection to favoring any particular section in the award of public work, when the money to pay for it comes from that section, but all outside of the favored spot should be properly warned.

To omit this caution in the original call, as was done in the case of the Harvard bridge, would seem to imply a strong obligation in the awarding commission to accept the lowest responsible bid, regardless of location. To do anything else is to lay the Commission open to the charge, whether justly made or not, of having simply invited the outside bids to keep local bidders within reasonable bounds and to obtain data for comparing and checking local prices. This might be considered as a shrewd business move, but it would be very unfair to the rejected outsiders, and it is an open question whether, under the circumstances, they could not obtain legal redress.

As this award was directly contrary to the ordinances of the cities interested it might also be claimed that the Commission, by its action, was practically reestablishing a practice long prohibited by law in nearly every large city in this country. Experience has taught us that, as a rule, it is unsafe to leave such awards to the unchecked judgment, or interests of any body of men for the time being in control. In this particular case the award was made with the best of motives, but with less scrupulous agents a decision might have been given that would have harmed the local treasury quite as much as foreign bridge builders.

In the interest of honest open competition, and of cities and contractors generally, it is to be hoped that hereafter the "lowest responsible bidder" will either be awarded the work, or be properly cautioned beforehand that his chances will only rank second to those of the responsible home bidder who most nearly approximates to his price.

The Quaker Bridge Dam and High Masonry Dams Generally.

In response to the calls of the New Croton Aqueduct Commission, of March 1886 and June 1887, Chief Engineer B. S. CHURCH and Consulting Engineer A. FTELEY, have submitted a report on the subject of high masonry dams, both curved and straight in form. This report has just been published, and from it we make the following brief abstracts:—

The first subject considered is the straight *vs.* the arched plan for the Quaker Bridge dam. This question is discussed mathematically and by diagrams, and Mr. CHURCH concludes that it is impossible to construct a curved dam at Quaker Bridge which will act as an arch in any appreciable degree, and that consequently there is no valid reason for risking the complicating and serious rupturing strains which a curved dam will produce; or, for the increased expense it would entail. This conclusion is verified in the report by an actual application to the dam proposed, fully worked out.

Mr. FTELEY presents a brief but very valuable synopsis of research in the question of high masonry dams throughout the world. The purpose of this compilation and review is not to prove the advisability of the construction of the Quaker Bridge dam, for that is placed beyond any reasonable doubt by high engineering authority, but to give additional confidence in its success with the doubting few by a consideration of what has elsewhere been done in the way of high masonry dams, although of less magnitude. To this end Mr. FTELEY illustrates to a common scale the great dams of ancient and modern times now existing, and investigates and criticises their section and resistance to pressures. In this work the author has presented a most valuable resumé of authorities on this subject.

The vital point of this section of the report is the detailed study of the conditions and proper section for the Quaker Bridge dam which is to impound 30,000 millions of gallons of water. Space forbids anything but a brief review of the position taken by the engineers responsible for this great work. The distribution of strains on the base and horizontal joints of the dam have been computed by formula (1) on the method of De BEAUVE. by which the pressure at each end of the base or joint is given by one of the two following formulæ:

$$(1) \qquad p = 2\left(2 - \frac{3u}{l}\right)\frac{W}{l}$$

$$(2) \qquad p = \frac{2}{3}\,\frac{W}{u}$$

according as u is greater or less than $\frac{l}{3}$

In these formulæ

l = length of base or joint.

p = pressure per unit of surface at one end of base or joint.

u = distance from point of application of the resultant to same end of base or joint.

W = total pressure on base or joint.

Formula (1) was used with the understanding that it indicates at the end of the joints, pressures evidently higher than the actual ones, thus adding a factor of safety of important though uncertain value. This whole question is fully treated and worked out in the report. In making these calculations the weight of the masonry was an uncertain factor; but weights of 156.25 lb., and 125 lbs. per cu. ft. of masonry being assumed, and the pressures found for each on the front face, the contrasted results showed that a small error in the expected weight would not seriously effect the reliability of the profile.

In connection with this subject of weight is discussed the effect upon the weight of the submerged portion lying between the bed rock and the riverbed. Mr. FTELEY takes the position that if the masonry was porous enough to admit water under ordinary hydrostatic conditions, the weight would be effected thereby. But as the dam, at the lower part, is to be so thick and the masonry of such quality that it can be reasonably supposed that the water penetrating it will be mostly, if not wholly, in a capillary condition, and that the whole mass may be considered for calculation as an impervious monolithic mass, rigidly and imperviously connected with the rock bottom, it consequently does *not* lose weight by the fact of its being in water. But even if we admit that the water does exert some upward pressure on the dam, as claimed by others, the result would not disturb to any objectionable degree the conditions of stability otherwise established. For these reasons as given above drains in the mass of the dam were deemed unnecessary and their presence might be injurious.

The profile of the dam is deduced from a simple and practical formula devised by Mr. ED. WEGMANN, Jr., Special Asst. Eng. intrusted with the mathematical computation. This formula and its application are given in full but will not bear intelligent explanation in the space at our command at present, especially as diagrams are essential to its full understanding.

The next points of importance are the height of the crest of the dam above the water line and the capacity of the weir for surplus water. The heights of 13 ft. above ordinary water mark and 7 ft. above extreme high water have been fixed for this dam, and the length of overflow is 1300 ft.

Rubble masonry has been used in the majority of existing structures and the engineers see no reason to depart from this practice here. Concrete can not be depended upon as being impervious enough to prevent percolation under great pressure and cut stone is obviously too costly. In this dam the largest stone will, with few exceptions, not exceed 2 tons in weight; the courses will be roughly levelled up every 5 ft., be well bedded and all interstitial spaces filled with selected or properly shaped stone with great projections hammered off. The point of vital importance will be to completely fill all cavities remaning with mortar.

The excavation to bed-rock will be 80 ft. deep as a maximum, and though many plans have been suggested for timbering, etc., it is deemed most advisable to open this trench without side protection, but to maintain it by long slopes on each side. This will facilitate the work of excavation, permit free inspection of the bed-rock and a proper treatment of all seams and fissures. To carry the Croton river over this trench it is proposed to build two temporary wooden dams, of little height, above and below the excavation and to connect them by a wooden flume. This flume should be placed at one side of the work and not over it, as originally proposed. And as it would be exceedingly expensive to main-

tain a flume 200 ft. wide as once figured, a width of 60 ft. is now adopted which would carry the average Spring freshet of the Croton, and so designed that any rise above this mark can pass off in ample channels, prepared for this purpose on the rocky hillside, and safely fill the trench and allow the freshet to pass over the work without causing more than repairable damage. This risk is preferable to the maintenance of the larger channel during several years. As the work rises above the level of the river, an arched opening can be left for the passage of the flume, to be filled when the dam is nearly completed.

As to cements to be used, imported Portland is recommended for all work next to the rock bottom and sides, with mortar of one cement to two of sand. The same mortar would also be preferable for the work of the last season on the upper part of the dam, as it acquires hardness in shorter time than domestic brands, and is better adapted to withstand the pressure of the dam when filled at once. For the bulk of the masonry, a mortar of good domestic cement, or Portland 3 to 1, would be sufficient.

Mr. FTELEY concludes his report with tabular statements of the great dams of the world, with their purpose, plan, dimensions, water-shed, weights, profiles, etc.; and also a synopsis of data for adopted section of the Quaker Bridge dam, with numerous diagrams illustrating formulæ and theory.

CORRESPONDENCE.

"Clark and Mingo Creeks."

WILMINGTON, N. C., Dec. 10, 1887.

EDITOR ENGINEERING NEWS:

I am sorry to see the "Clark and Mingo Creek" article again appearing in your paper, page 423, issue of Dec. 10, 1887. Had I dreamt that you would have brought this up again, I would have written you long ago to prevent you from again falling a victim to careless statements and recklessly written letters.

I believe myself qualified to speak upon this subject, because both streams are within the limits of my river and harbor district, and have both been examined and reported upon by me after examination by myself in person.

You say "$75,000 was allotted for these streams." As a matter of fact, no money has been yet allotted for the improvement of these streams, and only about $400 for their examination and survey.

The article says that "Lieut. ABBOT went down to make the survey, and began a search among the creeks and inlets of the coast, and spent several weeks in that labyrinth questioning negroes and whites without result." In matter of fact, Lieut. ABBOT's office is in Charleston, S. C., and he was not obliged to step outside of his office during his search for these creeks, a search naturally limited to an examination of the map of the State within the geographical limits of his own district, and to inquiries made by writing to Congressmen who were supposed to have asked for the examination and survey of these particular streams. Lieut. ABBOT, not being a native of South Carolina, and having lived in the State but a few years, could hardly be expected to know the names of all the rivers and creeks of the State, and very naturally applied to those persons whom he supposed should have known.

Congressman AIKEN intimates that Mingo creek and Clark's creek are streams "into whose dry bed water must be dipped from elsewhere to establish a commercial stream." In matter of fact, the word "creek" is a misnomer, since either of these two streams would be called a river by Northerners. I examined 21 miles of Mingo creek by the aid of a steam launch, and found these 21 miles to have an average width of 120 ft., and an average depth of 7 ft. at low water, A steamer of 80 ft. length, 30 ft. width, 5½ ft. depth of hold, and about 80 tons burden was then making bi-weekly trips over the greater part of this river and carrying about $365,000 worth of goods per year between that point and Georgetown, S. C., an average distance of 100 miles per round trip. Mingo creek is in fact a river of about 45 miles length, and 300 square miles area of drainage basin; it drains and serves as the main outlet of a tract of country not traversed at present by any railroad; its exit to the Atlantic ocean is already well secured by a freely navigable channel of at least 400 ft. width and 9 ft. depth at low water; its navigation at present is obstructed only by sunken logs and "sways" and by overhanging trees; and the expenditure of a few thousand dollars, say $15,000, would probably increase its commerce by $150,000 *each year*. Surely this is not "a creek into whose dry bed water must be dipped from elsewhere to establish a commercial stream."

Clark's creek is the local name for the southern outlet of Lynche's creek; it is never dry, and during the greater part of the year as at present, from 100 to 200 ft. wide, and from 9 to 12 ft. deep. Lynche's creek is a stream of about 160 miles length, and 1,365 square miles of drainage basin, including a good deal of very fertile land. The northern mouth of Lynche's creek is not well suited to its use by boats since it is so placed as to be yearly blocked up by the driftwood of the Great Pedee river, but Clark's creek, the southern mouth of Lynche's creek, is so placed that the proper expenditure of a few thousand dollars (say $7,500) will put Lynche's river in immediate communication with the ocean and with ocean schooners and steamers of 8 ft. draft. Surely this is not a stream "into whose dry bed water must be dipped from elsewhere to establish a commercial stream." Clark's creek is a stream of revolutionary fame; Black Mingo P. O. is named in the U. S. Postal Guide; both are within 100 miles of Charleston, S. C., and there appears to be no good excuse for their being unknown to prominent South Carolinians such as Congressman AIKEN and the editor of the Charleston *News and Courier*.

Other Congressmen and other people knew of both these streams and their worth; and as soon as it was discovered that the examination of these streams had by mistake been assigned to the wrong officer, the mistake was rectified, and the streams were promptly found and examined, with the results above stated.

Since you have been misled in this matter, and since your paper may thus mislead others, will you not correct the wrong already done, as far as possible, by giving as much publicity as possible to the above statements.

Very truly yours,

WM. H. BIXBY,

Captain of Engineers in charge of the River and Harbor district containing Clark and Mingo creeks.

[We are indebted to Capt. BIXBY for setting us right in this matter, and are glad that in this case there was ground—and water—for an appropriation. Our authority was the published letter of Congressman AIKEN, and it now looks as if we, with the press very generally, had been the victims of a piece of political "bunkum."—ED. ENG. NEWS.

Army and Civil Engineers.

PHILADELPHIA, PA., Dec. 12, 1887.

EDITOR ENGINEERING NEWS:

In your issue of 16th is a letter from "Engineer" calling attention to the apparent inactivity of the committee of the Executive Board of the Council of Engineering Societies on National Public Works, etc.

Permit me to ask you to refer this letter to him, stating that the labor involved has not been slight, and that the subject is not forgotten, but there are times when silence is golden, and in some kinds of operations it is injudicious to publish plans to inform your opponents of your policy—and opposition to this great undertaking is expected as shown by the statements made by your correspondent.

If he can be of service to the committee in giving data which may be of use, and will co-operate, I shall be pleased to have him uncover his *nom de plume* and drop me a line.

Very truly yours,

L. M. HAUPT.

Army and Civil Engineers.

GREENVILLE, MISS., Dec. 15, 1887

EDITOR ENGINEERING NEWS:

In your issue of Dec. 10, I observe a communication headed "Army and Civil Engineers," which is, as usual, unsparingly condemnatory of the present system. There is something to be said on the other side. I do not at all deny that the service as now managed is unsatisfactory to the civil engineers employed in it, if for no other reason than that the avenue to promotion is utterly barred beyond a certain point. But I do emphatically assert that so far as the public interest is concerned, the management of the army engineers is successful and economical, and there appears to be some reason to doubt whether a purely civil administration would be an unmixed improvement.

The respect wherein the army system is most efficient appears to me to be its strict subordination and accountability—and this is secured by having each employé directly responsible to his immediate superior. The officer in charge of the District appoints, directly, only his principal assistants. He selects his men, fixes their pay, assigns them their work. If they are inefficient or insubordinate, they may be discharged at a moment's notice. The principal assistants in their turn, select whom they please for the charge of the different departments of their work—and so on down. This is of course pretty much the same system that is pursued in the executive organization of private corporations; but it is not the usual course of public departments—where the tenure of office has a certain permanency, and an officer may be utterly inefficient, incompetent or refractory, and yet cannot be got rid of without a tedious and circuitous process, if then. If you wish to secure faithful service and prompt obedience from a man, let him understand that he looks to you for retention in office and promotion. If you would have him jealous, contumacious and obstructive, let him be independent of you, and unremovable, or accountable only to a common superior.

I have met many officers of the Corps of Engineers, and have served under several of them, and it is the exception when they are overbearing or insolent to their assistants. Familiarity, of course, is hardly compatible with good discipline, in either civil or military affairs, and a self-respecting subordinate will neither expect nor desire it. In truth, I think that here, as elsewhere, it depends mostly upon the man himself how he is treated by his official superiors. A self-contained dignity, that does not aim to trench upon the line that separates him who receives orders from him who gives them, will always be respected. Advances toward undue familiarity may and should be repelled. It is true that this may be done kindly, and not rudely or haughtily, but this depends upon the nature of the man and not upon the fact whether he is a soldier or a civilian.

If a perfect civil organization could be secured, it would, no doubt, be highly desirable. I cannot see any probability that such perfection would be attainable, without great advances in civil-service reform. A striking merit of the present system is its absolutely non-partisan nature. Within its limited sphere, appointment and promotion in the civil part of the army engineering service depend almost entirely upon competency and efficiency. An officer appoints his assistants as a captain does his non-commissioned officers, so that they may relieve him from as much labor and anxiety as possible, and his only earthly object is to get the best men. In a strictly civil system, it seems probable if appointments are to be made at large, that it would degenerate into a political machine. If it is to be entered from the lower ranks only, by examination or otherwise, it would run the risk of becoming a mere bureaucracy, entrance into which would be as impossible to the outsider as it now is into the Corps of Army Engineers. I doubt whether the higher ranks of the Coast and Geodetic Survey are any more accessible than the corresponding grades in the army. There would be the further evil of irremovable officers and lessened responsibility.

Unquestionably, it is far from pleasant to the capable engineer to arrive at the grade of principal assistant, with a salary of $175 or $200 a month, and to know that no matter how great his ability he can never get any higher. But no one compels him to remain in the service. If he leaves his place, then a dozen others are ready to take it, some of whom, if not equally able will at least be sufficient for the purpose. The work will not stop or suffer.

The army engineers, so far as I know them, appear to me as a rule to be able, candid and unassuming men, differing little, in any respect, from other intelligent engineers. They have not had much experience in subordinate positions and are sometimes placed in charge of work with which they are unfamiliar. This is no doubt an evil. Indeed, there

are drawbacks enough to the present system, most of which are enumerated by your correspondent and have been often enough enlarged upon. Many changes could be made that would be welcomed by the profession of civil engineers. Whether they would be of corresponding benefit to the work, I do not know.

I am a civil engineer myself; I have been out of the Government service for several years, and it is not probable that I shall ever be in it again. But I have had some experience in it, and I have its workings constantly under my eyes. I speak, therefore, not unadvisedly, and I believe without bias.

W. S.

Our Railroad Construction Maps.

COLUMBUS, O., Dec. 7, 1887.

EDITOR ENGINEERING NEWS:

We are in receipt of your issue of Dec. 3rd, enclosing series of maps No. 4 for Southern States. We think this is a *most excellent* feature of your paper, and have forwarded our copy to one of our traveling men in the South, and therefore wish another copy. We find these maps of great assistance to us in determining where the most active railroad building is in progress. We trust they may appear often.

Your respectfully,
Kilbourne & Jacobs Mfg. Co.

[We have received many similar letters,—ED. ENG. NEWS.]

Trench Blasting.

MADISON, WIS., Dec. 13, 1887.

EDITOR ENGINEERING NEWS:

On the subject of "Trench Blasting" mentioned in ENGINEERING NEWS of Nov. 19th and Dec. 3rd., I would state that in the excavation on 5th avenue and 34th street for the New York Steam Co, during the fall of 1885, of which I had charge, it was found necessary to cut through a solid ledge of gneiss rock, part of the trench being 11 ft. deep and the rock within 2 ft. of the surface; the rock was blasted from both ends of the trench working towards the middle, using dynamite cartridges of high power, and a battery, in some instances "double loading" the holes, that is, part of the charge at the bottom and part higher up. To do better execution, as many as six or more holes were fired instantaneously.

The rock to be blasted was covered with boards the full width of the trench, three and four courses deep, crossing them every 4 or 5 ft. with pieces of plank, and loaded with stones. They were in no instance thrown out of the trench, although within 30 ft. of Mr. WM. B. ASTOR'S dwelling not a light of glass was broken. By using a battery all preparations were made, and there was hardly a moment's detention of traffic or travel on the streets. By the use of board and plank in this manner it seems the concussion is broken to some degree thereby lessening the liability of fracturing glass in windows. Use of fascines I would certainly recommend for this purpose. Yours very truly, H. S. MACMINN,
Asst. Engr. Chicago & Northwestern R. R.

Effect of Cold on Iron and Steel.

Office of Superintendent, No. Pac. R. R.
GLENDON, M. T., Dec. 14, 1887.

EDITOR ENGINEERING NEWS:

In respect to the question of the effect of cold on iron and steel it may be well to note what "Trautwine" says, page 467, as to what is conclusively proved by SANDBERG'S experiments as regards behavior of metals under impact in severe cold. It might be well to have these tests given more completely. Yours truly,

F. W. D. HOLBROOK.

[The note referred to in "SANDBERG'S experiments" show conclusively that although these metals may perhaps bear as much *steady* force, *gradually* applied, in winter as in summer, yet their resistance to *impulse* or *sudden force*, is not more than ½ or ⅓ as great in severe cold; which renders them less flexible and less stretchy. It is probable that this fact does not receive as much attention as it should in proportioning iron bridges, etc.

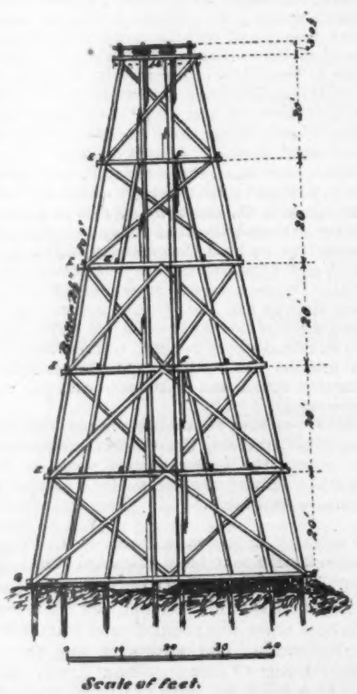
We cordially endorse this statement. We are satisfied that too hasty conclusions have been drawn from a few laboratory tests showing the non-effect of cold. We do not assert that it has a great affect but we think the evidence tends that way. If Mr. SANDBERG will send us fuller details as to his tests, as we have no doubt he will on seeing this note, we shall be pleased to go into the matter more fully,—ED. ENG. NEWS.]

Unequally Spaced Trestles.

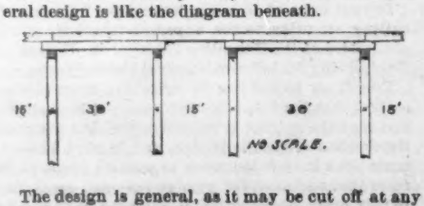
TEXARKANA, Tex., Dec. 3, 1887.

EDITOR ENGINEERING NEWS:

You have had some papers on trestle work lately In a high trestle a considerable economy in timber results from using a 30 ft. span alternately with a



15 ft. in the manner shown. It comes in handy to cross a creek, and was proposed by undersigned, to cover the case of a coal railway, crossed at an angle of skew double the width of the square span. Observe that the ends of stringers have a good bearing. There are many very high trestles on the Vancouver Island railway lately built, and their general design is like the diagram beneath.



The design is general, as it may be cut off at any sill, and makes a stiff structure. The leading feature is all the posts battering, except two in the center, which prevents rocking, and admits of a high trestle being safely crossed before the sway bracing is put on. These trestles have been built to a height of 190 ft., and groan less under load than any trestles that the undersigned has seen (or heard).

H. P. BELL.

Rainfall Observations.

Signal Office, War Department.
WASHINGTON, D. C. Dec., 17, 1887.

EDITOR ENGINEERING NEWS:

Referring to your editorial on "A Defect of the Signal Service," under date of Oct. 1, 1887, I have the honor to herewith transmit to you advance proofsheets of the October monthly *Weather Review*, in which the Chief Signal Officer has treated, as far as possible, the question of heavy rains during October, as shown by the records of this service for the past seventeen years. It is the intention of this office to continue this discussion by months. A systematic effort has been made to make the data for succeeding months more complete and full than for October. In addition the Chief Signal Officer has issued instructions to the observers, calling their especial attention to heavy rainfalls; copy of which will be furnished you when printed.

The Chief Signal Officer is obliged to your valuable paper for calling his attention to this defect in the service as regards data valuable for the engineers of the country. It will be gratifying to the head of this bureau if the varied business interests of the country will call his attention to any defects in the current system, or to the necessity of data in any other form than such as is now furnished. The Chief Signal Officer is especially desirous that the work of this service shall be carried on in such manner as to be of the greatest practical utility to the country at large, as well as to the special professions. The full October review will be sent you when published and the succeeding reviews during the coming year. The Chief Signal Officer has been given to understand that the engineers of the country are especially interested in this matter of maximum rate of rainfall, and he advises your paper that he will be glad to further your wishes as far as possible. His estimates for the coming year for instruments is $2,000. If the engineers of the country are in earnest about this matter and will persuade Congress to appropriate $2,000 or $3,000 for the purpose of buying self-registering rain gauges, efforts will be made to spend the money economically and to distribute the gauges so as to completely cover the country.

I am, very respectfully,
Your obedient servant,
A. W. GREELY, Chief Signal Officer.

The Bureau of Harbors and Waterways.

CHICAGO, Ill., Dec. 16, 1887.

EDITOR ENGINEERING NEWS:

A correspondent in your issue of 10th inst., refers to the organization of the "Council of Engineering Societies on National Public Works," instituted at Cleveland, in Dec., 1885, and April, 1886, and the appointment of committees to mature a line of action, and states that nothing further has been heard of it. Very likely this is true of others, and I take this opportunity to make a general statement for the benefit of those interested in the movement who are not members of engineering societies represented in the Councils.

An Executive Board was created to promote the purposes of the Council. This Board has had several meetings, appointed committees, raised enough money to keep out of debt a part of the time, and matured its reports and a line of action. Of late, considerable expense has been borne by individuals. The Board expects to make a call for a working fund at an early day to print and circulate its proceedings and reports and promote its objects in all legitimate ways. After the societies and the profession have considered this literature, the occasion will doubtless be opportune to call a meeting of the Council for further instructions.

The policy of the Executive Board has been to report results rather than anticipations. The committees of the several societies have been advised from time to time of the progress made and have cooperated. Great individual labor has been performed at much personal sacrifice. It is anticipated that the results will justify the trust consigned to the Board.

After a full canvass of the situation, it was concluded that the matter was too immature and the time not ripe at the last session of Congress. Since then the question has broadened and lost the narrow basis of class preferment which had appealed to some. Individuals have been led to discuss the question in magazines and in the press. At present the situation is as auspicious as possible and no derilection has been committed. If adequately supported, the issue will be fully made to Congress and the country.

The spirit of your editorial is excellent. It is difficult for those who have spent a good portion of their professional lives in the service not to feel re-

sentful towards the present conditions of civil employment. It is but natural that this should sometimes be visited on the personnel or even individuals who in some cases richly deserve it. But above and behind it all are confessed evils of legislation and of administrative method, which have thrown our river and harbor bills into disrepute and give little actual result for the large expenditure of the last few years. There is nothing in present methods which gives an earnest of any coordination of work or the development of any system of improvements as a whole. The remedy is to fundamentally change the manner of appropriations and the character of the executive organization by which they are to be applied.

The broad phases of this important issue are sufficient to justify a radical change for the better—it cannot be worse—and let the discussion be confined to these and not degenerate into a question of personnel. A correct system will do justice to all interests. The Executive Board has endeavored to so mature their conclusions as to meet the approval of all patriotic citizens, including the thinking men of the present Corps of Engineers, U. S. A.

The Executive Board has failed to find anyone who did not believe in a change to better methods. It is then simply a question of organization and mass movement to overcome the inertia of the established order. However long it may take, no doubt the Council will continue until it has accomplished the object of its creation. It is simply the agent of the societies for a specific purpose.

The logical and final outcome is to be the establishment of a Department of Public Works to include all the technical (scientific and constructive) bureaus, with a view to administrative system and responsibility and coordination of endeavor.

Respectfully, L. F. COOLEY,
President.

PERSONAL.

EDMUND L. ZALINSKI, whose name is so well known in connection with his work on the dynamite gun, has been promoted to the rank of Captain in the U. S. Artillery after 21 years continuous service.

F. K. BAXTER, of Utica, N. Y., has been engaged by the Board of Trustees of Herkimer, N. Y., as engineer for the water-works. He is now preparing the plans and specifications, and proposals for the work will be advertised as soon as possible.

G. W. BARTLETT, Superintendent of the Western Division of the New York, Pennsylvania & Ohio R. R. has resigned to accept the position of General Superintendent of the Buffalo, Rochester & Pittsburg R. R., with headquarters at Buffalo, N. Y.

DR. FERDINAND VANDERVEER HAYDEN, widely known in engineering and scientific circles from his valuable work in connection with the U. S. Geological Survey, died in Philadelpia on Dec. 22. Dr. HAYDEN'S work in the exploration of the western territories extended over a period of 20 years and was of great commercial as well as scientific value.

DONALD ALLEN has been appointed Superintendent of the South & North Alabama division, Louisville & Nashville R. R., with headquarters at Birmingham, Ala. He succeeds R. S. MINER.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—General meeting of Dec. 21. Mr. WM. B. HUTTON presiding. The Secretary announced that the next Annual Meeting would open on Wednesday, Jan. 18, 1888, at 10 A. M. An official programme, stating the general business and arrangements made for that day, will be issued as soon as possible. The paper of the evening was on "The Venturi Water Meter: an instrument making use of a new method of gauging water: applicable to the cases of very large tubes, and of a small value only, of the liquid to be gauged." read by the author, Mr. CLEMENS HERSCHEL. This is the application of the principles of the *vena contracta* to the measurement of volumes of water by inserting this "venturi," as it is called, in the line of a main, and by obtaining coefficients for the sudden check of flow, or drop in the normal hydraulic gradient, and from this loss of head calculating, the volume of water passing through the venturi. Mr. HERSCHEL made the experiments here set forth for the Holyoke Water Power Co., for which he is the Chief Engineer. Two sets of experiments were made: the first with a venturi, or contraction, of 1 ft. diameter in a 3 ft. main, and the second with a 3 ft. venturi in a 9 ft. main; this contraction of one-third in each case being the result of careful study of the action of the *vena contracta*, and assumed as giving the best results.

The proportions of the larger instrument, were as follows, the smaller one bearing the same, geometrically:—The venturi was 3 ft. in diameter by 1 ft. wide, made of cast-iron lined with brass and with its joints poured with Babbitt metal to prevent any leakage of air; around the exterior of this throat-piece was a series of 9 air-chambers communicating with the water by 9 cylindrical holes. This venturi connected, by rounded angles, two conical tubes made of dressed pine staves hooped with cast-iron bands. The entrance cone had a length of 17.09 ft. and end diameters of 9 ft. and 3 ft., and the discharge cone had a length of 69.80 ft., with similar end diameters; the total length of the instrument being 87.39 ft. For experimental purposes this was set up in a flume connected with the company's works, and provided with measuring tanks, weir, hook-gauges, etc.

To study the effect of the contracted water vein and to measure and compare the forces at work at the venturi itself and at points just above and below the instrument the following appliances were used; At the venturi proper, and connecting with its encircling air-chambers was a vacuum gauge, or water barometer, and at points on the cylindrical main, just above and below the intersections of the cones with this main, were placed two piezometers, or instruments for measuring the compressibility of the liquid passing in the main at these points. By carefully studying the several forces at work at these three points, the loss of head due to the contracted vein was obtained and coefficients secured that by simple formula showed the amount of water actually passing that point. The detailed results of the experiments made on the large and small venturis were fully set forth in the paper, and the coefficients obtained from the two sets of experiments agreed within about 2 per cent, although as shown the two tubes were of widely contrasted proportions.

In the beginning of his paper the author pointed out the disadvantages of the accepted methods of measuring the value of great quantities of water. The magnitude of the experiments made by him, can best be appreciated when we consider that a horse and buggy could be driven through the large main used, and that the volume of water measured was equivalent to 130,000,000 galls. in 24 hours, or about 30 per cent. more than the daily consumption of the City of New York. While these experiments are yet in their infancy, and, as Mr. HERSCHEL says, the method of observation can be much simplified, there is promise in it of great usefulness to every one interested in the measurement of flow in water mains. The exact range of the "venturi meter" can only be fixed from further experiment; but from the close coincidence of results in widely different but somewhat crude instruments, there seems to be little doubt that it can be applied to water mains of almost any size. One direct and most useful application of this new instrument would be in the New Croton Aqueduct for the determination of the New York consumption. In the discussion which followed the reading of the paper, Mr. CHURCH had no doubt that this could readily be done under very favorable circumstances. Mr. BRUSH also pointed out its usefulness on long lines of city mains, where large quantities now diverted at branches on the main can only be guessed at.

A very cordial invitation has been received by the American Society of Civil Engineers, from its members in Milwaukee, Wis., asking the Society to hold its Convention of 1888, in that city. The invitation is heartily endorsed by the Mayor of Milwaukee, the Hon. EMIL WALLBER.

Connecticut Association of Civil Engineers and Surveyors.—The annual meeting of the Association will be held Tuesday, Jan. 10, 1888; probably at the office of City Engineer BUNCE, in Hartford. The meeting is expected to be the largest and most interesting yet held and will probably be continued through the evening. Besides the election of officers and members papers will be read by G. W. FULLER, on "Submarine Foundations"; E. P. AUGER, on "The Effluent Pipe, Middletown Water Works;" T. H. MCKENZIE, on "Mason Work," and probably others. The discussion upon the "Rental Value of Hydrants," opened at the November meeting, will be continued, and members connected with water-works are requested to forward to C. E. CHANDLER, of Norwich, any statistics relating to the above subject. Members are also requested to send questions for the question-box to the Secretary, and to bring instruments, samples of materials, plans, photographs, blue prints, etc., for exchange or exhibition. The programme will be issued later. D. S. BRINSMADE, Secretary, Birmingham, Conn.

Ninth Annual Meeting of the Ohio Society of Surveyors and Civil Engineers.—The ninth annual meeting of the Ohio Society of Surveyors and Civil Engineers, will be held in Columbus, O., January 10, 11, 12, 1888. The present indications are that the meeting will be the best ever held by this society, and all have been good. After the President's address, the papers to be presented and discussed are as follows: "Judicial Functions of Surveyors," HOMER C. WHITE, Warren, O. "Protection from Incompetency," GEO. R. GYGER, Homeworth, O. "The Public Domain," J. T. BUCH, Cardington, O. "Twenty one Years Possession", E. D. HAZLETINE, Hazleton, O. "Steel Tapes as Standard" J. B. JOHNSON, St. Louis, Mo. "Roadmakers' Material of Ohio," Prof. EDWARD ORTON, Columbus, O. "State Topographical Survey," J. A. HANLON, Massillon, O. "Report of Committee on Civil Engineering," C. A. JUDSON, Sandusky, O. "Report of Committee on Drainage," E. D. SHREVE, Bucyrus, O. "Philosophy of Underdrainage," J. ARNETT, London, O. "Catfish," F. M. KENNEDY, Washington C. H. "Construction, Comparative Cost and Efficiency of Tile Drains and Open Ditches," E. B. OPDYKE, Bryan, O. "Irrigation in Kansas," J. S. HUMPHREY, Garden City, Kan. "Report of Committee on Highways," D. W. PAUSPEL, Sidney, O. "Two Mile Assessment Pike," E. W. DIMOCH, Ottawa, O. "Construction of Turnpikes," G. S. INNIS, Columbus, O. "Notes on Paving," THOS. WICHENDON, City Engr., Idaho, O. "Cleveland City Pavements," M. E. RAWSON, Cleveland, O. "Street Crossings and Sidewalks," R. A. BRYAN, Portsmouth, O. Street Grades and Monuments," CHAS. S. LEE, Marysville, O. "Monumenting," F. HODGEMAN, Climax, Mich. "Construction, Maintenance and Repair of Short Span Highway Bridges," S. A. BUCHANAN, Bellefontaine, O. "Bridge Strain Computation," Prof. C. N. BROWN, Columbus, O. "Bridge Construction Details and Use of Slide Rule," H. E. LEWIS. "Moving of Bridges," THOS. H. JOHNSON, Asst. Engr. P. C. & St. L. Ry. "Piling," JULIAN GRIGGS, Engr. Scioto Valley Ry. "Pile Foundations for County Bridges," F. M. DAVIDSON, West Manchester. "Masonry as Applied to R. R. Work," A. G. PUGH, Columbus, O. "Puzzles for the Engineer," W. A. GUEN, Sidney, O "Water Works Construction," J. B. STRAWN, Salem, O. "Circular Water Works," W. C. ROW, Circleville, O. "Springfield Water Works," WM. SHARON, Springfield, O. "Mortar," B. F. BOWE, Columbus, O. Difficulties of Surveying in Virginia Military District," WM. REEDER, London, O. "Landscape Gardening," J. L. CULLY, Cleveland O. "Duplication of Drainage," JOS. N. BRADFORD. "Railroad Location," S. F. ROCH, Mt. Sterling. "Outfit for R. R. Survey." BENJ. THOMPSON.

Special Rates at Park Hotel R. R.; rates 2 cts. per mile. For further information address W. H. JENNINGS, Columbus, O.

LATEST CHANGES OF ADDRESSES, AMERICAN SOCIETIES OF CIVIL ENGINEERS.

THOMAS APPLETON, Res. Engr., Chicago, Kansas & Nebraska Ry., Topeka, Kan.

AUGUSTUS P. BARNARD, 28 West Twentieth St., New York City.

EDWARD CANFIELD, Chf. Engr., New York, Ontario & Western Ry., Middletown, N. Y.

JAMES DUN, Chf. Engr., St. Louis & San Francisco R. R., St. Louis, Mo.

H. D. GATES, Deputy City Engr., San Francisco, Cal.

JULIUS E. HILGARD, 1204 Massachusetts Ave., Washington, D. C.

WILLIAM H. KENNEDY, Chf. Engr., Oregon Railway & Navigation Co., Portland, Ore.

SAMUEL KILLEBREW, Box 109, Eagle Pass, Texas.

EDMUND LIBBY, Wilmington, Del.

R. R. MINTURN, care Chf. Engr. Chicago, Milwaukee & St. Paul Ry.), Milwaukee, Wis.

A. T. MOSMAN, U. S. Coast Survey, Washington, D. C.

The Influence of Sugar upon Cement.*

This paper contains the results of some experiments, made by the author, assisted by HENRY HOBART PORTER, Jr., E. M., to determine the influence of sugar upon both natural and manufactured cements.

The addition of saccharine matter to cements, for the purpose of obtaining increased strength, is not new; it was first brought to the notice of the author during the past year by articles and letters published in the scientific periodicals. Mr. GUILDFORD MOLESWORTH, the well-known engineer, wrote from Simla (India), August 28, 1886, to Mr. SAMUEL CROMPTON, as follows: "With regard to your addition of sugar to mortar, it is a practice that has been in use in the Madras Presidency from time immemorial." It has been the usual custom in that country to add a small quantity of the coarsest sugar—"goor" or "jaghery," as it is called—with the water used for gauging the mortar. There are also in some of the old English records, statements where sugar and other substances were added to mortar for the purpose of imparting extra strength. (*See Railroad and Engineering Journal*, January, 1887.)

The following tests were made to conform to the

* Read by Harry De B. Parsons, New York, before the Philadelphia meeting of the Am. Soc. of Mechanical Engineers.

system recommended by the Committee of the American Society of Civil Engineers. (Transactions, November, 1885.) The machine used was a "Riehle Brothers Standard Cement Tester;" the form of the mold and the shape of the jaws being those adopted by the above committee.

Thecement was passed through a No. 74 sieve, having 5,476 meshes to the square inch; was thoroughly mixed with a hand-trowel, and placed in the molds without pressing or ramming; the greatest care being taken that the briquettes should be made under like conditions, in order that the tests might be relative one to another. The briquettes were exposed to the air for 24 hours and then placed in water, where they remained till broken by the Riehle Tester. This water was syphoned off every third or fourth day and replaced with fresh. A constant temperature was maintained between 60 and 70 deg. Fah.

The tests were divided into three classes—Series A, B. and C.

SERIES A.

In these tests the sugar was added in the form of refuse molasses from a sugar refinery. This as analyzed by W. D. HORNE, chemist, contained as follows:

Cane sugar	49 00
Carbonate of potash	10.00
Water	22.50
Vegetable and mineral impurities	18.50
	100.00

For each briquette a quantity of this molasses was taken to furnish the requisite percentage of sugar; then water was added till the required amount of liquid for gauging the cement was obtained, namely, 35 per cent by weight. The cement used was "Dyckerhoff and Soehnes German Portland." The tests were somewhat imperfect, owing to the fact that the standard solution of molasses, was found to alter in chemical composition and could not be kept constant. The action was so great as materially to affect the strength of the briquettes, and thus a large number of tests were discarded as being unreliable. However, the series of tests which contained one per cent of molasses. gave results as recorded in the following table, the figures representing the tensile strength in pounds per square inch.

TIME OF TESTS	1 Day.	2 Days.	1 Week.	2 Weeks.	4 Weeks.	2 Months.	3 Months.	4 Months.
Neat	70½	160	298⅝	388	436	446	456½	485¾
With 1% Molasses	20	27		74⅛		178¾	363½	

In a graphic representation it was noticed that while the curve of neat cement rises steep and full, the curve representing the mixture of cement with one per cent of molasses is considerably lower; rising, however, at the end of two months very noticeably, and approaching the curve of neat cement, which the writer is led to believe, by his experience, it would havecrossed if the tests could have been extended further. The figures given are the averages in each case of from four to six tests. The general appearance of the briquettes was good, although after a time most of them became covered with a slimy mold.

SERIES B.

In order to avoid the ill effects produced by the molasses, this series of tests was made with pure crystallized sugar. A known weight of sugar was dissolved ina measured quantity of water to form a standard solution. The proper quantity of this solution was added to the water for working up the cement, as in the test where molasses was used. The manipulation of the briquettes, was in every way

TIME OF TESTS	1 Day.	2 Days.	1 Week.	2 Weeks.	4 Weeks.	2 Months.	3 Months.	4 Months.
Neat	70½	160	298⅝	388	436	446	456⅜	485¾
With ½% sugar.	9		51⅛	388	480		522¾	563¾
" ¾% "	4⅜		41⅛		411		552¾	
" 1% "	2		34⅛				527¾	571⅛
" 1½ "	2		47		403¾		572¾	
" 2% "	2		50		334		537¾	

similar to that of "Series A." The cement used was the same, namely Dyckerhoff's German Portland. No trouble whatever was experinced with the solution of sugar or with any mold on the briquettes. The amount of sugar used for each briquette is the stated percentage on the weight of cement therein. The results may be tabulated as follows, the figures representing, as before, the tensile strength in pounds per square inch.

SERIES C.

This series of tests was made with F. O. Norton's Rosendale (natural) cement, with the same standard solution of sugar as in "Series B." The manipulation and treatment of the briquettes were the same as before, with the exception that 40 per cent of water was used for gauging.

The results obtained were as follows:

TIME OF TESTS.	1 Day.	1 Week.	2 Weeks.	4 Weeks.	2 Months.	3 Months.
Neat	4 ⅝		62	118½	225½	255½
With ½% sugar	15	25½	27	74	243¾	299½
" ¾% "	27½			99	238	301¾
" ⅞% "	6			76	154¾	264
" 1% "	1				34	181¾

From a comparison of the curves of strength, we are able to note very clearly the effects produced by the addition of sugar.

With the molasses the cement was retarded in setting, and very much more so than when the same cement was used with the addition of pure sugar. This was probably due to the great quantity of impurities which the molasses contained; and, perhaps also to some active chemical operations which may have taken place before the cement became thoroughly set. The same slow setting was also exhibited by the F. O. Norton cement, when large percentages of sugar were used, (as for example say 3 and 4 per cent) the cement requiring at least 48 hours before it became sufficiently hard to remove from the molds. In fact, some of the briquettes of the Norton cement, when mixed with only 2 per cent. of sugar, were so soft at the end of 28 days in water that they would not stand handling, but crumbled when touched. In cases where more than 2 per cent. of sugar was added to the Portland, and more than 1 per cent. to the Norton cement, both were rendered practically useless. The sugar did not seem to have any chemical effect upon the briquettes, for on examining the surfaces of fractures, crystals of sugar were easily detected. These crystals varied in size, were sometimes single and at others were clustered together; generally they were found in the air-holes throughout the briquette. Of course the sugar on the outside, or very near the surface of the briquettes, was dissolved by the water in which they were placed. On the contrary, the sugar in the middle of the briquettes seemed to have collected in these small air-holes and formed its crystals as the cement set. The reason why the sugar should give increased strength to the cement, appears to the writer to be more mechanical than chemical. That is to say, the sugar by its presence in the briquette appears simply to retard the setting of the cement, and thereby permits the chemical changes in the cement to take place more perfectly. In order to insure the greatest accuracy, all tests were rejected whenever there was the least cause for suspicion; thus there are only recorded herein about 70 per cent. of the tests made.

THE Connecticut River R. R. has just finished a system for heating stationary cars in their yard near the company's shops, devised by WM. F. RAY, Asst. Supt. It consists of a series of underground steam pipes from the boiler house, running to partially buried boxes, where heavy rubber hose can be connected with the steam pipes of a car. The side tracks where the cars are cleaned after a trip, and are dusted for the start is opposite to the boiler house, but the pipes could be carried a greater distance with but little more pains. All that has to be done when it is desirable to heat a car or a string of cars, is to lift the cover from one of the traps and connect it with the steam piping under the car. A whole string of say a dozen or 15 cars can be heated as well as one. The connection can be made at the intervening cars. Any car can be shut off. There are about a dozen of the traps scattered up and down the yard so that it is an easy matter to make connections with the steam.

AT the close of the past year there were in use, upon the railways of the United Kingdom, 15,400 locomotive engines, 35,216 carriages for the conveyance of passengers, 12,673 other vehicles attached to passenger trains, 468,537 wagons of all kinds used for the conveyance of live stock, minerals, or general merchandise, and 12,664 other carriages or wagons used for other purposes, making the total number of vehicles of all descriptions upon the railways of the United Kingdom, 528,090.

As the fertile and arable areas of our public lands have become settled and occupied, public attention is being directed toward the great sections of the western territories which were formerly supposed to be so arid as to be practically valueless. It has been conclusively shown that the soil on a great portion of these desert tracts needs only a proper amount of moisture to yield large crops; and with the high prices which farm products bring in these regions, irrigation schemes have been found to be profitable and have attracted a large amount of capital.

At the present time several new enterprises are under way and projected in northern New Mexico and southern Colorado whose projectors propose to tap the tributaries of the upper Rio Grande and run large canals parallel to the course of the Rio Grande and at some distance from it.

In discussing these projects the New York *Nation* calls attention to the fact that in times of drought the Rio Grande has at present none too great a supply from its upper tributaries to keep up the flow over its sandy bed in the lower part of its course, and supply the small irrigation canals already established there.

If the fertile lands on the lower Rio Grande bottoms should have their water supply endangered in this manner, some difficult legal questions would arise concerning the liability of the parties who in effect propose to construct a new Rio Grande at the expense of the old. It seems quite certain that the agricultural development of the Southwest by irrigation schemes is likely to be pretty sharply limited by the scanty supply which the natural water courses can spare. It is an interesting question as to how much this supply can be reinforced from subterranean sources, and whether the increase of cultivated land will have a similar effect on the humidity of the climate to that which has been noted in the Northwest.

The International Railway Congress at Milan.

The results of the International Railway Congress at Milan can be summarized as follows:—Metal ties were generally approved of; and in ordinary track, larger ties, stronger fish-plates and good ballast frequently renewed were recommended. Mild steel was commended for large span bridges, with especial attention paid to its selection. While steel proper was condemned for locomotive boilers, homogeneous metal was approved of, and a jet of steam or water suggested as an improvement on sand for securing wheel friction. A mixture of vegetable and mineral oil was recommended for lubricating axles, and white metal for bearings.

The influence of American practice was apparent in several of the changes recommended. Among these can be named the change in form of cars so as to reduce the dead weight as compared with the weight of passengers carried; the preference expressed for the continuous use of engines by having gangs of engine-drivers instead of each driver having his own engine; the collection of tickets on the run instead of at stations, etc.

Improvement in continuous brakes were demanded; but the opinion was expressed that it was impossible to apply these to freight trainsowing to the great diversity of Continental rolling-stock. For car-lighting, the use of electricity was considered as not yet fully developed for this purpose; enriched gas has hitherto given the best results. Car-heating was little considered, and at present was confined to moveable foot-warmers.

For secondary lines a greater simplicity of service was recommended. Continuous brakes were deemed unnecessary on such lines, and a longitudinal passage through the cars was suggested as decreasing the expense of collection of tickets. They also propose to do away with special baggage-cars, guards at level crossings, etc. All of which is not very encouraging to travellers on secondary lines.

Incidentally it might be mentioned that the meetings of the Congress were held in the famous La Scala theatre, which claims to be the largest in Europe.

This theatre holds from 3,000 to 3,500 persons, but has such well arranged and numerous exits that it can be cleared in 8 minutes. The stage is 121 ft. deep, 82 ft. wide and 90 ft. high to the roof. The theatre is lighted by 2800 incandescent lamps of the Thomson-Houston systems.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 445.

Bismarck, Dak.—The works were commenced June 1, 1887, and accepted Dec. 1, 1887; they were designed by J. ALBERT MONROE, C. E., who was also Constructing Engineer. Messrs. MORISON & CORTHELL were Consulting Engineers. The contractors for masonry, foundations and reservoir were Mayonck & Byrne, of Bismarck; for trenching and pipe laying, Mooney & Danaher, of Grand Forks, Dak.; for pumping machinery, Dean Steam Pump Co.; for pipe, specials and hydrants, R. D. Wood & Co., of Phila., Pa.; for valves, Galvin Brass Works, Detroit, Mich. The prices for trenching were as follows; 12-in., 19 cts. per ft.; 10-in., 18 cts., 8-in., 16 cts.; 6-in., 15 cts. The prices for pipe laying were as follows: 12-in., 18 cts. per ft.; 10-in., 17 cts.; 8-in., 16 cts.; 6-in., 15 cts. The franchise is for 20 years, and the price per hydrant, $100. The franchise is owned by the Bismarck Water Co. President, E. H. BLY; Secretary, ALEXANDER HUGHES. The present population is about 4,000.

Oswego, Kan.—The works were commenced in May, 1887, and accepted November 14, 1887; they were designed by J. JONES, who also acted as Constructing Engineer. The contractor for the entire works was J. Jones, of Wichita, Kan.; for buildings, M. S. Douglass; pumping machinery, valves and hydrants, N. O. Nelson Manufacturing Co., St. Louis, Mo.; for stand-pipe, Palmer & Son, Kansas City, Mo.; for pipe and specials, South St. Louis Foundry. The stand-pipe is 10 ft. diameter by 140 ft. high. The franchise is for 21 years, and the price per hydrant $50. The franchise is owned by the Oswego Water Supply Co.; President, W. M. SWENTZELL; Secretary, F. L. GREENE. The present population is estimated at 4,000.

CONSTRUCTION NEWS.

Water.

Ottawa, Can.—Professors Marsan and Tourchot have made their report on the analyses made by them of four samples of Ottawa river water. The analyses show a considerable percentage of organic matter, but this is found to be of a woody nature and due to the forests through which the river flows and the quantity of timber annually floated down the stream. From the report it would appear that impure water is not the cause of the epidemic of typhoid fever, from which the city is suffering, and the cause must probably be looked for in the drains.

Wabash, Ind.—It is reported that owing to the fact that the filth from a number of hog, ponds, stables and outhouses drain into the reservoir from which the Wabash Water Company draws its supply, the Board of Health has presented a report to the City Council declaring it unfit for domestic consumption, and urging that steps be taken immediately to prevent the pollution of the supply.

The American Water-Works Co., of Chicago, asks the Stock Exchange to list $2,000,000 of first mortgage bonds. This is one of many corporations outside of railroad companies that are asking or preparing to ask the listing of their securities in this market, not so much for general trading as to be able by the tests of "bid" and "asked" quotations to have a criterion as to the market value of their stocks and bonds; and it is true also that securities listed on the Exchange and thus having a fixed market are ordinarily of use as collateral in the making of loans with banks, while certificates not known on the Exchange are likely to be tabooed and given no attention.—*N. Y. Times.* (This company is successor to the Omaha Water-Works Co.)

Jersey City, N. J.—It is generally acknowledged that the present water supply from the Passaic river is unwholesome and dangerous. The proposed supply from the Morris canal is not considered advisable, and the general opinion is in favor of the proposition of JOHN R. BARTLETT to furnish a supply from storage reservoirs in the New Jersey watershed. The towns of Paterson, Passaic and Montclair are among the places already supplied from these reservoirs. The Board of Public Works will advertise for proposals for furnishing a water supply.

Norwich, Conn.—The Board of Water Commissioners has issued the report for the year ending March 31, 1887, being the fourteenth annual report. The superintendent reports that the water supply was ample and of excellent quality. The aggregate daily consumption is equal to about 82.3 galls. per capita, the actual consumption per capita is proved by meters to be only about 30 galls. per day, which shows that there is a large proportion of waste, and the general adoption of meters is recommended. During the year 1,230 ft. of ½-in., 1-in., 1¼-in. and 4-in. pipe have been laid, including lead, cast-iron, and wrought-iron cement-lined; 88 new services were laid, and 3 hydrants and 2 gates put in. Cast-iron pipe was substituted for 3,211 ft. of 4 and 6-in. cement-lined pipe. The report includes tables of the rainfall, and the rise and fall of water, and also a financial statement. Dr. S. L. GEER is President of the Board; JOHN A. MORGAN, Secretary; JUNIUS A. BRAND, Superintendent.

A Chance for Water-Works Contractors.—

BROWNSVILLE, TEX., Dec. 8, 1887.

EDITOR ENGINEERING NEWS:

By our postmaster yours was placed in my hands, as I am one of the aldermen here, and interested in seeing a future water-works in our town. There are no water-works here. Well-to-do people have large cisterns, and use rain water almost entirely; poor people use the river water, it costs 6¼ cts. per barrel in Mexican coin. We are a city as yet with no railroad connections with the outside world, and probably will not be able to build water-works until we have larger revenues. We are isolated, and water is delivered by carts, which bring it from the river near by. Our city lies almost on a dead level without any hill or elevation of any kind. We want some advice as to the best system to adopt, and want to correspond with some good contractors, to get an idea of the cost of water-works on a small scale; the laying of pipe to be extended as circumstances would justify from time to time. We are on the bank of the Rio Grande, the water of which at ordinary stages is not more than 15 ft. below the city level. The water is generally more or less muddy and requires settling before use. Reservoirs are expensive. Would not stand-pipe and patent filter to purify the water, be our best plan to adopt? I. W. HOYT.

Water-Works.—*Maine.*—Boothbay. The Boothbay Water Co., H. A. HANCOX, President, has made a contract with the town for a water supply. There will be 5 miles of pipe, 22 double nozzle hydrants, a pump to lift 400,000 galls. per day to a height of 160 ft., and a stand-pipe with a capacity of 250,000 galls. The town will pay an annual rental of $1,450 for the 22 hydrants for 25 years, and $50 each for all additional hydrants.—Skowhegan. The water company will not finish the works this winter but will stop work till the spring. The work on the north side of the river and on the island will be completed and water in these parts turned on about Jan. 1. The new works will cost $125,000.

New Hampshire.—Dover. The city council has adopted a report by the City Solicitor as to how the new city water-works should be built and managed. He recommended the election by the council of 3 water commissioners, not members of the council, and the issue of $275,000 in bonds for construction.

Massachusetts.—Vineyard Haven. The new water-works were formally opened Dec. 15.—Malden. The water commission has been authorized to continue the driven well experiments.

Maryland.—Salisbury. The Salisbury Water-Works Co. has commenced erecting its works. The pipe are distributed on the roads. The stand-pipe will be 75 ft. high, with a capacity of 30,000 galls. The capital stock is $50,000. S. P. DENNIS, W. H. JACKSON and others are directors.

Virginia.—Manchester. W. H. White, of New York, has made a proposition to establish a water tower.

Kentucky.—Dayton. Water-works are projected and a proposition is to be submitted by a New York company. Address City Clerk HAYWOOD.

Alabama.—Cullman. The Cullman Land & Improvement Co. has increased its capital stock to $10,000, will sink its artesian well deeper and build water-works.—Uniontown. The artesian well has been abandoned by an inexperienced contractor at a depth of 650 ft. the contract depth being 1,000 ft. The city desires to find a party to complete the contract. Address J. C. WELCH, Mayor.

Ohio.—Cleveland. The plans and specifications for the new water tunnel have been prepared by Superintendent WHITELAW. The tunnel will have a daily capacity of 60,000,000 galls., cost about $300,000 and occupy 2 years in construction.—Defiance. The Defiance Water Co. has been incorporated with a capital stock of $200,000.—Washington. Water-works are contemplated. Address F. JOHNSON.

Indiana.—Kentland. Steps will soon be taken towards issuing the water bonds voted in November.

Illinois.—Murphysboro. Water-works have been established.—Creston. The City Council has granted WM. S. MERCER & Co., of New York City, a franchise for 25 years for the construction of a system of water-works, paying a yearly rental of 4,400. The franchise granted to James Gamble in the spring was declared void on account of non-compliance with its terms.

Dakota.—Bismarck. The new water-works were tested Dec. 13, with satisfactory results. The city council accepted the works by a unanimous vote.

Nebraska.—Lincoln. An additional water supply is proposed to be obtained from neighboring streams, pumped to a reservoir.—Holdredge. Plans have been adopted for water-works to cost $50,000. A. A. RICHARDSON of Lincoln, is Chief Engineer.—Beatrice. The city will enlarge the water-works and lay 21,200 ft. of pipe at an estimated cost of $19,800.

California.—Porterville. A water supply will be obtained from the Tulare river and pumped to a reservoir on an elevation east of the town.

Texas.—Beaumont. A contract for a system of water-works has been made with W. E. THOMAS and associates. There will be 2¼ miles of pipe, 28 hydrants and a stand-pipe.—Paris. The Paris Water Co. has been incorporated with a capital stock of $20,000, by M. P. KELLY, J. D. THOMAS and L. P. HARRISON. M. P. KELLY, of Georgetown, has the franchise for the works.

Canada.—Kingston, Ont. The water-works system will be improved. New mains will be laid, two Hyatt filters put in, and a tank 70 ft. high erected at the reservoir. These improvements will cost $100,000 in addition to the $130,000 paid by the city to the company for the purchase of the works.—Welland, Ont. Water-works are being built, and the water supply is proposed to be taken from the Welland canal.—Toronto. The engineer in charge of the pumping works has called attention to the large number of repairs needed by the Hunter & Inglis engine. The Water-Works Committee has decided to make such repairs as are absolutely necessary and to refer all other matters relating to the engine to the subcommittee appointed to meet Hunter & Inglis.—Bridgetown, N. S. The town has just completed water-works, gravitation system, with reservoirs. A. W. FORBES, of Crafts & Forbes, Boston, Mass., was Engineer. The contractors were Sutherland & Cochran; the pipe and gates were furnished by Black & Co., of Glasgow, and the hydrants by the Windsor Foundry Co. The price for trenching and pipe laying was 25 cts. per ft. The town owns the works. Population, 2,500.

Proposals Open.

Water-Works.—City wants to contract for works to be built in the spring. Surveys and estimates completed. J. W. NORVELL, Mayor, Bristol, Tenn.

Gas Works.—About 5 miles of mains to be laid. W. L. WHITAKER, Texarkana, Ark.

Water-Works.—Franchise plan. THE WATER-WORKS COMMITTEE, Centralia, Ill.

Sewer and Culvert.—Salt glazed sewer pipe, 12 and 18-in.; basins and manholes. Brick culvert with stone invert, 42 x 48 ins. JOHN HUNKELE, Street Commissioner, Newark, N. J. Dec. 27.

Highway Bridge.—Across Stones river at Stewart's Ferry. Bids for the entire work or for (1) masonry and foundations, (2) bridge superstructure, (3) earth or rock grading. Plans and specifications at the office of W. F. FOSTER, 3 Berry Block, Nashville. JOHN OVERTON, Chairman Committee of County Court, Nashville, Tenn. Dec. 28.

Street Lighting.—Gas or other illuminant. GEO. R. CONNER, Commissioner of City Works, Brooklyn, N. Y. Dec. 29.

Post Office.—At Coaticook, P. Q., A GOBEIL, Secretary, Department of Public Works, Ottawa, Canada. Dec. 29.

Bridge.—Across Menominee river between Menominee, Mich., and Marinette, Wis. Draw span 192 ft.; 2 spans 110 ft.; 900 ft. of iron or Howe truss spans; 350 ft. pile bridge. Engineer R. E. FARNHAM, 284 La Salle street, Chicago. S. M. STEPHENSON, Menominee, Mich., or J. A. VANCLEVE, Marinette, Wis. Dec. 30.

Pipe and Specials.—Pipe; 165 tons 12-in., 136 tons 18-in., 80 tons 20 in., 710 tons 24-in. Specials, 4 tons for 12-in. pipe, 7 tons for 18-in., 12 tons for 20-in., 44 tons for 24-in. H. E. SICKLES, Secretary, Special Water Commission, 25 North Pearl street, Albany, N. Y. Jan. 3.

Pump, Boilers, Water Tower, Buildings, Etc.—At Central Islip, L. I. One duplex steam pump, 2 boilers, water tower and tank, engine and boiler house and other buildings. THE COMMISSIONERS OF PUBLIC CHARITIES AND CORRECTION, 66 Third Avenue, New York City. Jan. 4.

Heating Apparatus.—For 16th precinct station house. GEO. R. CONNER, Commissioner of City Works, Municipal building, Brooklyn, N. Y. Jan. 5.

Pipe and Castings.—About 750 tons of cast-iron water pipe and a quantity of special castings, R. CLARK, Secretary, Water Commissioners, Merritton, Ont., Canada. Jan. 10.

Sewers and Drains.—In several streets. THOS. G. SMITH, President, Board of Public Affairs, Cincinnati, O. Jan. 16.

Court House, Jail and Jailer's Residence.—At Pineville, Ky. Plans and specifications at the office of McDonald Bros., Bull Block, Louisville, and the office of J. M. Pursifull, Pineville. THE JAIL COMMISSIONERS, Pineville, Bell county, Ky. Jan. 26.

Contracting.

Tunnel.—A tunnel will be built under the railroad crossing at Seventeenth street, Birmingham, Ala., at a cost of $12,500. Address W. H. HUGHES.

Pumping Machinery Wanted.—The Board of Water Commissioners, Sandusky, O., will advertise for proposals for pumping machinery. Address CHAS. A. JUDSON, C. E., Superintendent of Water Works.

Water Supply.—The Board of Public Works, Jersey City, N. J., will advertise for proposals for a new water supply, delivered at the Belleville reservoir.

Foundations and Dock Work.—The contract for rebuilding the dock and pile foundation for the warehouses of the Anchor Line and the Western Refrigerating Co., at Chicago, Ill., has been awarded to W. T. Casgrain & Co., of Milwaukee, Wis.

Machinery for Swing Bridges.—The Commissioner of Public Works, Chicago, Ill., has awarded the contract for machinery for the swing bridges at Randolph and Madison streets to the Excelsior Iron Works of Chicago, at $2 400 for each bridge.

The Union Iron Works Co., of Chattanooga, Tenn., will erect a larger plant in the spring. The company has the contract for 8-in. water pipe, pumps, boiler and stand-pipe for the water-works at Athens, Tenn. It is also building bridges.

The Roanoke Railroad & Lumber Co. has been organized under a charter from the North Carolina legislature, and has purchased saw mills, dry kilns, etc., at Reidsville, N. C.; also logging railroad, etc. The company has purchased land near Norfolk, Va., and will erect creosoting works for the treatment of piling and lumber. President, L. R. FREEMAN, Warren, Pa.; Secretary, E. B. FREEMAN, Norfolk, Va.

The Kanawha Improvement Co. has been incorporated at Charleston, W. Va., with a capital stock of $25,000.

Pile Revetment.—The advertisement for proposals for constructing a pile revetment at Ashland, Wis., have been withdrawn and bids will not be received. Work at this harbor will not be commenced at present. The work will be under the supervision of Capt. E. L. B. DAVIS, U. S. Engineer Office, Milwaukee, Wis.

The San Francisco Tool Co., of San Francisco Cal., has enlarged its works and has every department full of work. The company has a contract for making 15,000 meters for the Spring Valley Water Co., and is turning out 20 meters a day; 500 meters are also being made for San Diego, and other large contracts for the same kind of work are expected soon. Twenty of the new double-capacity hydraulic elevators made at these shops are now in use or in process of construction in this city. A pumping plant for San Diego, designed to lift water 265 ft., has just been completed, as has also a deep-well pumping plant for George C. Shreve, to be used at Mountain View. Other recent work in this line is a pump for San Lorenzo, with a capacity of 60,000 galls. an hour, a pump for Stockton with a capacity of 75,000 galls. an hour, and a 16-in. pump for John T. Porter capable of pumping 600,000 galls. per hour. The latter plant is to be used at Lodi for reclamation purposes. Three large pumping plants have recently been ordered by the Spring Valley Water Co., one with a capacity of 400,000 galls. an hour, another of 300,000 and another of 60,000. A pump for a local brewery that will lift 9,000 galls. of beer 75 ft. high in an hour is now in hand. Two top piledrivers for T. P. H. Whitelaw and one for the Grangers' Business Association at Port Costa have been turned out lately from the same works.

Railroad Contracts.—*Georgia, Carolina & Northern R. R.*—The contract for grading from Athens, Ga., to the Oconee river has been awarded to T. W. Powell, who will commence work at once.

Kansas City, Rich Hill & Southern R. R.—The contract for building the road between Rich Hill and East Lynne, about 40 miles, has been awarded to H. P. Selden, of New York.

Nashville & Knoxville R. R.—A contract has been awarded to Coffee & Ware, of St. Louis, Mo.

Seattle, Lake Shore & Eastern R. R.—The contract for an extension of this Washington Territory road to the Canadian boundary line, 80 miles, has been awarded to T. T. Sinclair & Co., of Port Henry.

Oxford & New Glasgow R. R.—The Department of Railways & Canals, at Ottawa, Canada, has awarded contracts as follows for 50 miles. Sections 1 and 3, J. O'Brien, of Renfrew, Ont., and Thomas Cooke, of Oxford, N. S.; Section 2, D. M. Sutherland, of Shubenacadie, N. S.; Section 4, Archie Stewart and Ralph Jones, of Ottawa. The total cost of the 4 sections will be about $400,000.

Cape Breton R. R.—The Dominion Government has taken over the contract for the east end of the road from Sims & Slater, of Ottawa, on the ground that the work was not being done fast enough.

The Sodom Dam.—The contract for the construction of the Sodom dam, in connection with the additional water supply for New York City, was awarded Dec. 19 by the Aqueduct Commissioners to Sullivan, Ryder & Dougherty, at $366,990. The contract prices were as follows:

MATERIALS.	QUANTITIES.	PRICE.	AMOUNT.
Removal of soil excavated and placed in spoil banks	4,000 cu. yds.	$ .20	800
Soil taken from spoil banks and placed	4,000 "	.20	800
Sodding	7,500 sq. yds.	.30	2,250
Earth excavation	50,000 cu. yds.	.35	17,500
Earth taken from spoil banks for refilling	30,000 "	.25	7,500
Extra haul of earth, every 100 ft. over 500 ft.	5,000 "	.01½	75
Rock excavation	10,000 "	1.50	15,000
Deep rock excavation	2,000 "	2.00	4,000
Timber for river work	25,000 ft. B. M.	50.00	1,250
Portland cement (barrels of 400 lbs.)	500 bbls.	2.75	1,375
Concrete masonry, 5 broken stone: 1 cement	500 cu. yds.	4.50	2,250
Concrete " 3 broken stone: 1 cement	500 "	5.00	2,500
Brick " American cement mortar	500 "	9.50	4,750
Brick " asphaltum mortar	500 "	10.00	5,000
Rubble " American cement mortar	32,000 "	3.75	120,000
Dry rubble stone masonry and paving	8,000 "	3.00	24,000
Rip-rap	2,500 "	1.50	3,750
Broken stone	2,000 "	2.00	4,000
Split stone masonry, dry	400 "	8.00	3,200
" " " mortar	100 "	8.50	850
Facing stone masonry, American cement mortar	5,000 "	10.00	50,000
Granite dimension stone masonry, Am. cement mortar	1,100 "	23.00	25,300
Face work, rubble stone masonry	12,000 sq. ft.	.30	3,600
Fine hammered (6 cut) face dressing	16,000 "	.75	12,000
Rough pointed face dressing	15,200 "	.20	3,040
Masonry, laid in American cement mortar, (1:1	4,000 cu. yds.	.30	1,200
" laid in Portland cement mortar, (1:1	500 "	1.00	500
" " " " " (1:2	10,000 "	.75	7,500
" " " " " (1:3	13,000 "	.50	6,500
Cast-iron hub and spigot straight pipe	135 tons.	100.00	13,500
Cast-iron specials, in place	100 "	120.00	12,000
Wrought-iron, in place	10 "	160.00	1,600
Cast and wrought-iron fencing	1,200 lin. ft.	4.00	4,800
Stop cocks, 48-in	2	1,200.00	2,400
" 36-in	2	850.00	1 700
" 12-in	5	75.00	375
Windows	3	25.00	75
Double door	1	50.00	50
Total			366,990

Pipe and Specials.—The following proposals for 1800 tons of 6, 10, 12, 20 and 30-in. cast-iron water pipe, and 132 tons of special castings, were opened December 13, by the Water Committee, City Council, Montreal, Canada:

Pipe.		Price per ton of 2,240 lbs.
A. T. Paterson, Londonderry, N. S	All sizes	$32 10
Alex. Gartshore, Montreal	do	32.48
Bellhouse, Dillon & Co., Montreal	do	34.00
R. McLaren & Co., Glasgow, Scotland	do	34 57
Middleton & Meredith, Montreal	do	34.99
R. N. C. Connal, Montreal	do	35.00
J. G. Somer, Montreal	do	35.00
Macfarlane, Strang & Co, Glasgow, Scotland,— (Turnbull & Co., agent, Montreal)	do	35.91
(Coghlin, agent, Montreal)	do	36.06
George Reaves, Montreal	do	36 65
R. D. Wood & Co., Philadelphia, Pa	do	37.35
A. Holden, Montreal	do	41.00
George Dibley & Son, London and Montreal	6 in., $37.15; 10-in., $36.30; 12, 20 and 30 in.	35.80
J. V. H. Taylor (for [illegible] & Co.), Glasgow	6-in., $35.50; 10-in., $35.20; 12, 20 and 30-in.	34.80
Clay Cross Co., Chesterfield, England	6-in., $37.08; 10-in., $36.72; 12-in., $36.11; 20-in., $35.87; 30 in.	35.87
Cooper, Fairman & Co., Montreal	6-in., $38.16; 10-in., $37.52; 12, 20 and 30-in.	36.89
Cox & Greene, Montreal	6-in., $36.96; 10-in., $36.10; 12, 20 and 30-in.	35.60

The contract was awarded to Alex. Thos. Paterson, of Londonderry, N. S., Canada.

Castings.—Chagnon & Co., Longueuil, $39.70 per ton; J. McDougall, Montreal, $46.20; P. Arnesse, Montreal, $46.20; A. R. Ives & Co., Montreal, $48; Bellhouse, Dillon & Co., Montreal, $50.50; B. I. Coghlin, Montreal, $55.77; T. T. Turnbull & Co., Montreal, $55; E. Chanteloup, Montreal, $60; Alex. Gartshore, Hamilton, Ont., $61.20; Cooper, Fairman & Co., $62.74. The contract was not awarded. LOUIS LESAGE is Superintendent of Water Works.

Street Railroad.—T. William Harris & Co., of New York, have been awarded the contract for the construction of the Savannah Street & Rural Resort Ry. at Savannah, Ga. There will be six miles of track: electricity or horse power will be used, probably the former. No pains will be spared to make this a first class road in every respect.

Kyanized Spruce Plank.—The Commissioners of Harvard Bridge, Boston, Mass., received the following proposals for 420,000 ft. B. M. of kyanized spruce plank: W. S. Barker, $24.30 per 1,000 ft. B. M.; A. M. Stetson & Co., $26.50. The contract was awarded to W. S. Barker.

Dredging.—The following proposals for dredging in Wappoo cut, South Carolina, have been received by Gen. Q. A. GILMORE, U. S. Engineer Office, New York City: Ross & Sanford, 22, 24 and 26 cts. per cu. yd. moved not exceeding 1, 2 and 3 miles. Charleston Dredging Co., 21, 23 and 25 cts., conditioned upon depth of water in approaches and width of channel to be dredged.

The Sodom Dam.—The Aqueduct Commissioners, New York City, received 17 proposals for the construction of the dam. The totals are as follows:

Sullivan, Ryder & Dougherty	366,990
J. S. Brown	377,615
Andrew O'Rourke	378 099.75
Paige, Carey & Co.	379,980
Ryan & McDonald	384,131
Smith, Ripley & Browne	430,360
I. V. Quackenbush	436,615
Clark & O'Hara	441,970
O'Brien & Clark	442,070
Nolan Bros. & Co	447,060
Henry Collins	448,650
Richard A. Malone	465,270
John Cox & Co.	484,147
Arnold & Stevens	493,870
Belden, Soule & Raynor	495,695
I. R. Byron	496,216
Miles Tierney	594,315
ENGINEER'S ESTIMATE	540,030

The contract was awarded to Sullivan, Ryder & Dougherty, the prices of whose bid are given above.

Water Tanks.—The Belt Railroad Co., at Indianapolis, Ind., will replace the wooden tanks in its yards with iron tanks on iron trestles. The improvement will cost $10,000.

Water Pipe.—The Trustees of Lake, Ill., will readvertise for proposals for water pipe. The Shickle, Harrison & Howard Iron Co., which was recently awarded the contract for pipe, has withdrawn, with the consent of the Board. The company feared the Board had not power to make the contract.

Pipe and Specials.—The Water Board, Philadelphia, Pa., has awarded contracts as follows: Camden Iron Works, Camden, N. J.; 3-in. pipe, 1.33 cts. per lb.; 6-in., 1.316 cts.; 8-in., 1.312 cts.; 10-in., 1.272 cts.; 12-in., 1.261 cts.; 48-in., 1.15 cts.; breeches pipe, 3.73 cts. McNeal Pipe & Foundry Co., Burlington, N. J.; 16-in. pipe, 1.239 cts. per lb.; 20-in., 1.228; 30-in., 1.196 cts. Gloucester Iron Works, Philadelphia; small and large specials, 2½ and 2.35 cts. per lb.

Steam Road Rollers.—At San Francisco, Cal., three 10 ton steam rollers have been built by a Mission street iron-works, and 2 more are being built. They are for the San Diego Pavement Co. and the Bituminous Pavement Co., of San Diego. They are designed for use in the laying of bituminous pavements, and one of the rollers of each engine is arranged to contain fuel in order to heat the pavement.

Water-Works.—The following were the proposals received Dec. 12 by the Water Trustees, Hammond, Ind., for the construction of water-works, the contract for which was given last week (p. 446): E. B. Wingate, Chicago; pumphouse, chimney and reservoir, $4,120; pumps and boilers, $3,271; stand-pipe, $4,301.80.—Eclipse Wind Engine Co., Beloit, Wis., $2,732, $4,450 and $5,778, for similar work.—South Bend Boiler Works, South Bend, Ind.: pumps and boilers, $4,500; stand-pipe, $5,200.—M. N. Walker & Co., Chicago: two boilers and fittings, $1,230.—Deane Steam Pump Co., Chicago: pumps only, 14 × 8½ × 10, each $585; 16 × 9½ × 10, each $710; 4½ × 2½ × 4, at $106.25; 18½ × 10½ × 10, $765. The contract was awarded to E. B. Wingate.

There will be a brick pumping house, with concrete floor, engine foundation and chimney. The reservoir will be of stone and brick, 30 ft. diameter and 9 ft. high in the clear, inside; it will be excavated in the ground. The stand-pipe will be of steel, 10 ft. diameter and 100 ft. high; the plates will vary from ⅜-in. at bottom to ¼-in. at top. The material to have a tensile strength of 60,000 lbs. per sq. in. and to be tested by the engineer. The horizontal joints will be single riveted lap joints, and the vertical joints double riveted lap joints. There will be 12 1¼-in. anchor bolts, with the necessary plates. The foundation will be 16 ft. diameter and about 10 ft. high; it will be of rubble masonry laid in cement mortar. The pumping plant will consist of two duplex, non-compound, pumping engines, with a daily capacity of not less than 750,000 galls. each with an ordinary piston speed of 100 ft. per minute; they are to be capable of working against heavy pressure and equal to throwing two 1-in. streams through 100 ft. of 2½ in. hose, to a height of 80 ft. There will be 2 boilers, 50 ins. diameter and 14 ft. 2 ins. long. The Chief Engineer is E. B. WINGATE, C. E. of Chicago. H. HALL is Superintendent of Water-Works.

The Toledo Foundry & Machine Co., Toledo, Ohio, have their new works in full operation, giving them several fold more facilities than the old premises. They have just finished two excavators, one for the Pennsylvania R. R., and the other for the Lake Shore & Michigan Southern R. R.

The King Bridge Co., of Cleveland, O., is making large additions to its works in that city, including two new shops, each 800 ft. long by 75 ft. wide. Without neglecting their highway business the company will pay more attention to railway bridge construction in the future, and the new shops are being fitted up with this end in view. They are now building the Grand Avenue bridge in St. Louis, with two spans of 250 ft. and one of 400 ft., 60 ft. wide over all. Their work on the new Cleveland viaduct will be completed in the next summer and work has recently been started on another bridge across the Mississippi at Minneapolis; they have recently finished a bridge at the same place.

RAILROADS

East of Chicago.

Existing Roads.

Kinderhook, Valatie & Stuyvesant.—

No. 45 Broadway.

NEW YORK CITY, Dec. 20, 1887.

EDITOR ENGINEERING NEWS:

The Kinderhook, Valatie and Stuyvesant Railroad is to run from Stuyvesant Landing on the New York Central & Hudson River Railroad, 25 miles south of Albany, *via* Kinderhook, Valatie and Niverville on the Boston & Albany Railroad, to Kinderhook Lake, a distance of 10 miles. The location is completed, most of the right of way has been secured, and about three miles have been graded by contractor JUDSON KINGSLEY of Troy. Further contracts are to be let about January 13, and it is expected to begin track laying by April 15, and have the road open for business by June 1. CHAS. D. HAINES, of 45 Broadway, New York City, is President, and J. R. PHELPS, of Kinderhook, is Chief Engineer.

F. H. SKEELE, *Secretary.*

Lake Erie & Western.—It is reported that the extension of the Minster Branch to Piqua, O., a distance of 18 miles, will be undertaken early in the spring, and surveys will be made this winter. The project was noted on our map No. 3.

Pennsylvania.—Work is being pushed on the elevated tracks upon the branch to Harsimus Cove in Jersey City. A report comes floating in from Muscatine, Ia., to the effect that the Pennsylvania officials have determined to build from Chicago to Omaha and Kansas City. The Mississippi river is to be crossed at Muscatine, and Mayor GOBBLE of that city, and members of the Board of Trade have organized a bridge company. The report states that "the Rock Island is somewhat disturbed by the statements." We extend our sympathy to President CABLE, and trust that the "disturbance" of the company he represents may be soon relieved.

Louisville, Evansville & St. Louis.—The Huntingburg, Tell City & Cannelton branch in Indiana, 23.7 miles in length, has been completed and will be open for business by January 1.

Baltimore & Drum Point.—Rodgers & Clements, the contractors for the Calvert County division of this Maryland line will complete the first five miles of grading by February 15. Further contracts are to be let shortly. Some changes in the surveyed route are under consideration by engineers GOLDSBOROUGH and BARNES.

Canadian Pacific.—The London *Financial News* publishes a long article discussing the proposal that the Canadian Government take steps at once to acquire and operate the whole system of the Canadian Pacific, on a guarantee of three per cent. to its security holders. The Canadian Pacific managers scoff at the matter as a solemn farce, and say that the government or any one else will not swallow up the company on a three per cent. basis.

Toledo, Saginaw & Mackinaw.—About six miles of grading has been finished on this Michigan road. The division now under contract, extends from Durand to East Saginaw, about 60 miles. P. H. KETCHAM of East Saginaw, is Vice-President.

Lehigh Valley.—The surveyors of the proposed Buffalo & Geneva road are still at work near Ithaca, N. Y. Three preliminary lines have been run between Van Ettenville and Geneva and a fourth is being examined.

Niagara Central.—Grading is completed between Thorold and St. Catharines, Ont., and the track will be laid early in the spring.

Fitchburg.—Work is in progress at Rotterdam Junction on the Erie Canal upon the grain elevator, terminal tracks, etc., which were described at length in this column some time ago. Considerable bridge building work is in progress along the line.

Housatonic.—At the recent annual meeting it was voted to build ten miles of road from Newtown to Huntington, Ct., to connect with the New Haven & Derby. It is also reported that the company will build the partly graded extension of the New York, Rutland & Montreal, from State Line to Lebanon Springs, New York.

New York, Pennsylvania & Ohio.—This company has agreed to lease when completed, the New Lisbon, East Liverpool & Southern Railroad. This line is to be built by a recently organized company, of which DANIEL CRAWFORD of St. Clair, O., is President, and GEO. MORLEY of East Liverpool, is Vice-President. The line will be about 15 miles in length. It is not improbable that the Nypano will extend it on down the river to Wheeling, W. Va.

New Projects and Surveys.

Vincennes, Oakland City & Owensboro.—

OWENSBORO, KY., Dec. 13, 1887.

EDITOR ENGINEERING NEWS:

Surveys are in progress on this line from Owensboro, Ky., *via* Boonville, Ind., Lynnville and Oakland City to Vincennes, about 70 miles. Work is light and the line can be built it is thought for $10,000 per mile. Contracts will probably be let by early spring. JAS. C. RUDD of Owensboro is President and W. B. EALLS is Chief Engineer. C. W. BRANSFORD, *Secretary.*

Williamsport & Northwestern and Binghamton & Southwestern.—A joint meeting of the stockholders of these two companies was held Dec. 15 at Williamsport, Pa. The following officers were elected: President, FRANCIS M. WARD of New Jersey; Vice President, EDGAR MUNSON of Williamsport. Secretary, CHAS. F. CAMP of Williamsport. It was voted to place the line under construction as soon as possible. The proposed length is about 120 miles. The line as surveyed was noted on map No. 3.

Castine & Bangor.—This Maine line is under survey by WARREN NICKERSON of Orrington. A. M. DEVEREAUX of Castine is General Manager.

Brantford, Waterloo & Lake Erie.—The city of Brantford, Ont., will vote Jan 2 on the question of granting a bonus of $50,000 to this company.

Port Clinton Short Line.—

PORT CLINTON, O., Dec. 15, 1887.

EDITOR ENGINEERING NEWS:

Surveys began Nov. 1 on the Port Clinton Short Line Railroad which is to run from Port Clinton westward *via* Oak Harbor, Elmore, Woodville, Bemberville, and Scotch Ridge to Bowling Green, a distance of 40 miles. Right of way is partly secured, and capital for building is promised. The enterprise is wholly independent of existing lines and will be carried through by the company direct, no contracts being let. It is hoped to begin tracklaying by April 1 next and open a portion of the line for traffic by July.

E. H. BRENNAN, *President*

An Ottawa dispatch to the St. Paul *Pioneer Press* is as follows:

"J. H. Stiggles, a New York broker and capitalist, is here applying for a renewal of a charter to build a road from Calgary, N. W. T., north to Athabasca Landing, beyond Edmonton. He says the road will be built within a few years. Mr. Stiggles is also taking up a scheme to build a railway from Quebec to the east coast of Labrador, and to place a fleet of fast vessels on the Atlantic. He thinks this would solve the question of quick transit to and from Europe, claiming that the passage could be made from Labrador to England in three and a half days.

The above item has a certain interest inasmuch as it shows what preposterous stories go floating around the newspapers unpunctured. If Mr. STIGGLES is a "New York broker and capitalist," he certainly does not figure as such in the directory of this city. The Calgary road may have some basis of, possibility; but those who are acquainted with the mild climate, fertile soil, and smooth level prairies of Labrador and with the warm and commodious winter harbors that line its coast will readily believe that Mr. STIGGLES' "Labrador through line" will prove as visionary as the gentleman himself appears to be.

SOUTHERN.

Existing Roads.

Kansas City, Memphis & Birmingham.—The last rail on the Aberdeen, Miss., branch, 12 miles in length, was laid Dec. 14. It is rumored that the company intended to extend this branch from Aberdeen to Selma, Ala., over the surveyed and partially graded line of the defunct Memphis, Aberdeen & Selma company.—A branch is under survey to the Coal creek mines, near Birmingham.

Natchez, Jackson & Columbus.—The holders of this company's securities are to decide soon whether to widen the gauge on the completed line, 100 miles in length, from Natchez to Jackson, Miss., and build the extension to Columbus or offer the road for sale or lease. T. J. NICOLL, the General Manager, advises the carrying out of the proposed improvements and is now in New York conferring with the bondholders of the road.

Shelby.—This line extends from Shelby Junction, 12 miles east of Louisville, Ky., to Shelbville, 20 miles, and is leased to the Louisville & Nashville. A syndicate headed by JACOB KRIEGER, of Louisville, Ky., has secured a majority of stock and are now endeavoring to secure an order of court to break the lease of the road. Should they succeed, they will at once extend the line from Shelbyville to Frankfort, about 25 miles.

Columbus Southern.—The final location and cross-sectioning is in progress on this Georgia road.

Brunswick & Western.—At a stockholders' meeting held Dec. 15 it was voted to sell the road, which extends from Brunswick to Albany, Ga., 171 miles, to the Savannah, Florida & Western Co.

Roanoke R. R. & Lumber Co.—This company whose headquarters are at Norfolk, Va., owns a road now used for lumber traffic which is projected to run from Plymouth to Reidsville, N. C., 36 miles. About 10 miles have been built at each end of the line and are now being operated. S. F. BURBANK, Plymouth, N. C., is Chief Engineer and General Manager.

New Projects and Surveys.

St. John's River.—This company was chartered in Florida on March 29 to build a railroad from Jacksonville to Ocala, by Dr. W. T. SYLVESTER, of Jacksonville. The line is now under survey by S. B. CARTER, of Palatka.

Canaveral & South Florida.—Chartered by H. H. HARRISON and others, of Canaveral, Fla., to build a railroad from Titusville to Canaveral.

Atlantic, Atlanta & Great Western.—This company's proposed line extends from Sheffield, Ala., *via* Atlanta, Ga., to Savannah. The length of the Atlanta & Savannah division, which is projected *via* Eatonton, Sparta and Waynesboro, is estimated at 235 miles and the cost is figured at $3,499,452. GEO. T. FRY, of Atlanta, is President.

Blue Ridge & Atlantic.—BAILEY THOMAS, of Athens, Ga., who is at the head of this project, is said to have secured the aid of JOHN H. INMAN. Mr. THOMAS proposes to take the Northeastern Railroad, of Georgia, which the Richmond & Danville has agreed to turn over to him, and extend it to Knoxville, Tenn. The history of the scheme and the legal difficulties in which it has been involved is long and complicated, and it may be doubted whether Mr. THOMAS will be able to secure the funds to carry it out for some time yet.

New Life Water Power & Granite.—This company was organized Dec. 13, at Conyers, Ga., to build a short railroad. WM. Y. PECK, of Monroe, is President. T. D. STEWART, of McDonough is interested.

Princeton, Marion & Ohio River.—This company which was incorporated in 1872 has just been organized at Marion, Ky., with J. W. BLUE as President and J. G. ROCHESTER, Secretary.

THE NORTHWEST.

Existing Roads.

St. Paul & Duluth.—Double tracking on this road between St. Paul and Gladstone, Minn., has begun. The distance is 11½ miles. Some sharp curves will be straightened and grades made easier. The work is to be completed intime for the heavy suburban travel of next summer.

Chicago, Milwaukee & St. Paul.—The work of taking out grade crossings on the Hastings & Dakota division in the city of Minneapolis is to begin very soon. The tracks will be lowered, and the streets carried over them by bridges.

St. Paul, Minneapolis & Manitoba.—A corps of engineers have begun work on the extension of the Duluth, Willmar & Sioux Falls line from Sioux Falls to Yankton, Dak., and it is supposed on southwest to Denver, Col.

Minneapolis, Sault Ste. Marie & Atlantic.—The first through train ran over the road from Minneapolis to the Sault on Dec. 15, carrying President W. D. WASHBURN and other principal officers of the road. The trip was made in 22 hours; the distance is about 495 miles, of which 350 miles have been built in 1887. The officers and managers of the company are to be highly complimented on their work of the year, and when the length of the line, the rough and uninhabited country through which it was built, and the very short time which has been allotted to perform a high grade of work, are considered it is certain that the achievement should be ranked as one of the greatest feats of railroad building of 1887.

New Projects and Surveys.

Minnesota & Dakota.—This Dakota company, which has been making surveys and obtaining rights of way for three months past, has let the contract for building its road from Fargo, Dakota, northwest 152 miles to a point 15 miles west of New Rockford, to JOB VOAK, of Massachusetts, the whole line to be completed in time to transport next season's wheat crop. HENRY CUTLER, of Fargo, is president of the company. It is rumored that the enterprise is backed by the Chicago, Milwaukee & St. Paul.

Minnesota Northern.—

WORTHINGTON, NOBLES Co., Minn., Dec. 14, 1887.

EDITOR ENGINEERING NEWS:

The Minnesota Northern Railroad is projected to run from the South line of the State of Minnesota *via* Worthington, Fulda and Currie to Fergus Falls. The line is now under survey and right of way is being secured. This enterprise is organized for the purpose of supplying a beautiful and fine stretch of farming country with a direct line of road to the coal fields of Iowa on the south and the Manitoba & Northern Pacific systems on the north, forming a part of a transcontinental line from Sabine Pass, Texas, north by the way of Kansas City, Mo., to Winnipeg and Hudson bay, making it eventually the most direct as well as the shortest line across the Continent (a long low grade road) that can be found. The company was formed by the business men along the line of road C. H. SMITH of Worthington is President, and B. Z. WOOLSTENCRAFT of Fulda is Chief Engineer. J. P. MOULTON.

Cairo & East Cape Girardeau.—This Illinois company are said to have obtained a trackage right over the Mobile & Ohio road from Cairo to Beach Ridge, a distance of 9 miles. From Beach Ridge the line is to run *via* Goose Island, Santa Fe and Thebes to East Cape Girardeau, 45 miles from Cairo. Surveys will begin early in the Spring and it is hoped to let contracts by May 1. FREDOLIN BROSS is President and HENRY WELLS of Cairo is Secretary.

Milwaukee, & Peoria.

Phœnix Building.
CHICAGO, ILL.

EDITOR ENGINEERING NEWS:

The recently incorporated Peoria & Michigan company will be consolidated with another corporation to form the Milwaukee & Peoria Railway Company. The projected route is *via* Mukwonago, Elkhorn Geneva Lake, Walworth, Haworth, Belvidere, Rochelle, Mendota and Bureau. The enterprise is independent of existing lines, and is projected to obtain a southeastern connection from Milwaukee to the coal regions of Illinois. Right of way is being secured, and surveys will begin immediately. Capital for building is to be secured by individual subscriptions and by a syndicate who will float the bonds. A contract for construction has been closed, and it is expected to push work so that tracklaying may begin by May, and the whole line be completed in 18 months from beginning work. Mr. E. H. WALDRON is President of the Company.

C. A. HASLETT, *Secretary.*

Wisconsin Midland.—Surveys have been made on this line from Fond Du Lac due north to the Michigan State line, 156 miles, and from Kaukauna to Sturgeon Bay, 72 miles. The northern line is projected 60 miles farther to L'Anse, Mich. Some local aid has been voted but no other funds of amount have been secured. There is now some prospect that the Illinois Central will take up the enterprise, in which case a line from Fond Du Lac to Madison would be surveyed and built at once. C. H. BENTON of Fond Du Lac is Vice President and N. BOARDMAN is Chief Engineer.

Springfield & Southern Illinois.—

219 So. 23rd St., ST. LOUIS, Mo., Dec., 17, 1887.

EDITOR ENGINEERING NEWS.—

Surveys were made on this line the past season from Pleasantville *via* Nashville, Carlyle, Greenville, Hillsboro, Harvel and Pawnee to Springfield, a distance of 125 miles. The work is fairly light. Over 60 miles of the line is level and the maximum grade on 50 miles is 50 ft. per mile. On two miles the grade exceeds this. A good part of the right of way has been secured and the prospect is good for the balance. Some additional work may be done on the surveys this winter but most will be deferred till spring. It is likely that a construction company will be organized this winter who will take up the the work of building the line and be ready to let grading contracts in the spring. RUFUS N. RAMSEY, Carlyle, Ill., is President and Judge AMOS MILLER, of Hillsboro is Secretary of the company.

GEO. W. DAVIS, *Chief Engineer.*

THE SOUTHWEST.

Existing Roads.

Fort Worth & Denver City.—At the annual meeting of the company at Fort Worth, Tex., C. F. MEEK, General Manager, reported that he expected to have tracklaying completed by Feb. 15 and as soon as possible thereafter to open for business the whole line, 800 miles in length. The company is now operating 138 miles from Denver to Pueblo, Col., and 277 miles from Fort Worth to Clarendon, Tex. Tracklaying is completed from Clarendon to appoint 80 miles beyond Cheyenne, in the Texas Panhandle.

St. Louis & San Francisco.—There is much discussion concerning the probable directions of the extensions for which the stockholders have authorized an issue of bonds. Among the probable lines are a Kansas City extension from Pierce City or Bolivar, Mo., and a line from Paris to Roberta, Tex., a distance of 65 miles. The Kansas Midland from Wichita to Ellsworth, Kan., will be pushed to an early completion, and it is stated will be extended south from Wichita down the valley of the Arkansas river to connect with the Indian Territory line. This road from Pierce City, Mo., to Sapulpa, Ind. Ter., 151 miles, over which but one train a day is now run, will be placed in good condition and the long delayed extension from Sapulpa across Indian Territory and the Texas Panhandle to Albuquerque N. M., to connect with the Atlantic & Pacific, will be at once pushed through. It goes without saying that the degree of activity with which the above programme will be carried out will depend very largely on the success of the financial managers in marketing their new bond issue.

Southern Pacific.—The work of raising the $75,000 subsidy asked by the company for building the 60 mile extension from Victoria to Beeville is making good progress, over half the sum has been raised, and the project seems to be in a fair way of being carried through.

Atchison, Topeka & Santa Fe.—Tracklaying is being pushed rapidly on the Kiowa extension across the Texas Panhandle, and is nearly to the New Mexican line. It is stated that several of the contractors who have been working on the Chicago, Santa Fé & California are to begin work at once on the extension of this line to Albuquerque, N. M.

Missouri Pacific.—The reason for stopping work on the new Dallas & Hillsboro line in Texas is stated to be scarcity of steel rails. The grading and bridging are nearly completed, and it is hardly likely that the stoppage of work will be more than temporary.—It is stated that the St. Louis, Iron Mountain & Southern is to abandon its line from Charleston to Birds Point, Mo., and cross the Mississippi at Belmont.

Chicago, St. Paul & Kansas City.—The Kansas City extension of this line from St. Joseph, Mo., is a topic of much interest at the Missouri river metropolis. President STICKNEY has personally visited Kansas City, and is said to have secured an entrance over the tracks of the Wyandotte & Northwestern from Leavenworth. As soon as spring opens work is to begin on the line from St. Joseph to Leavenworth.

Kansas City, Fort Smith & Southern.—On this Missouri road about 39 miles of grading was completed, and 5 miles of track were down at the time of the cessation of work some time ago, on account of lack of funds. The projected length is about 200 miles, and it is estimated that $2,000,000 would be required to complete the line. The original projector of the line was MATTHIAS SPLITLOG, a half-breed Indian of considerable wealth. Mr. J. C. CRAVEN, of Springfield, Mo., is now interested in the project, and is trying to obtain funds for resuming work.

New Projects and Surveys.

Kansas City & Sabine Pass.—

Bayard Building.
KANSAS CITY, Mo., Dec. 12, 1887.

EDITOR ENGINEERING NEWS:

The Kansas City & Sabine Pass Railway is to run from Kansas City, Mo., to Sabine Pass, Tex., a distance of 664 miles, *via* Pierce City, Mo., and Bentonville, Fort Smith and Texarkana, Ark. On the first division from Kansas City to Pierce City, 171 miles, surveys have been made, right of way is being secured, and contracts have been let to a construction company. The route is *via* Belton, Foster and Lamar, and the maximum grade is one per cent. The President of the Company is HARRISON M. JAMES of New York City. The New York office is No. 31, Broadway, Mr. J. W. NIER, Hall Building, Kansas City, is Chief Engineer.

AUSTIN KERR, *Secretary.*

Beloit & Nebraska.—This company has been chartered in Kansas to build a railway from Beloit, Mitchell Co., to the North line of the State in Jewell or Smith Co., a distance of 60 miles. The incorporators are A. L. WILLIAMS of Topeka and others, which indicates that the project is in the Union Pacific interest.

Chicago, Hannibal & Springfield.—This company has been incorporated in Missouri by ROLAND C. NICKERSON and JOSEPH LATHROP of Chicago and others, to build a railroad 250 miles in length from a point in Marion or Balls counties to Springfield, Mo. Surveyors are already at work on the line. It is stated with considerable plausibility that the scheme is backed by the Chicago Burlington & Quincy and that the line will be located at once ready for next season's work.

Panhandle.—This company has been chartered in Texas to build a railroad from Washburn, Armstrong county to Panhandle City, 25 miles. Among the incorporators are HENRY WALTERS of Baltimore and MORGAN JONES of Fort Worth and the line is thus evidently a branch of the Fort Worth & Denver City.

Houston, Central Arkansas & Northern.—This company, which was incorporated in Arkansas, Feb. 26, 1887, has finished its preliminary surveys and estimates and intends to begin construction by Feb. 1. The road will run from Little Rock, Ark., to Alexandria, La., about 300 miles. W. A. BRIGHT of Little Rock, is President and JAS. CONVERSE of Houston, Tex., is Chief Engineer.

Galveston, & Western.—Incorporated by H. F. FISHER and others of Galveston, Tex., to build a short suburban road.

Mississippi Valley.—

NATCHEZ, MISS., Dec. 12, 1887.

EDITOR ENGINEERING NEWS:

The Mississippi Valley Railroad is projected to run from near Arkansas City, Ark., to West Baton Rouge, La., 260 miles along the west Bank of the Mississippi river, connecting with the Missouri Pacific at Arkansas City and the Texas Pacific at West Baton Rouge. The line has been surveyed and right of way has been largely secured, but the time of commencing work is uncertain. E. BALDWIN is Chief Engineer and SANFORD H. STEELE 229 Broadway, New York City, is interested in the company.

HIRAM B STEELE, *President.*

Chicago, Oquawka & Kansas City.—On June 3 of the present year considerable interest was excited in Kansas City railroad circles over a rumored deal in railway charters. WALTER BROWN of Kansas City, representing some mysterious company (rumored to be the Pennsylvania) secured charters for an elevated railway near Wyandotte, Kan., a bridge across the Missouri near Quindaro, and the partially graded roadbed of the Parkville & Grand river railroad, 37 miles in length, from Quindaro to Lathrop, Mo. Since that time surveys have been in progress under Mr. BROWN'S direction and considerable real estate has been secured. The purposes and work of the syndicate have however been kept secret as far as possible. On Dec. 16, however, Mr. BROWN issued the following proposition to the voters of Wyandotte company from which some idea of the projects of the company may be obtained:

To the Taxpayers of Wyandotte county, Kansas:

In consideration of $200,000 aid to be voted by the county of Wyandotte, such aid to be in bonds of said county, running thirty years from date of issue and bearing 5 per cent. annual interest, the undersigned proposes to construct and maintain a bridge across the Missouri river at a point between Parkville, Mo., and the reservoir of the National water works company in Wyandotte county, Kansas. Said bridge to be a single track railroad and wagon bridge; to be built of steel and iron and to be first class in all respects. Said bonds are not to be delivered to the undersigned until the completion of said bridge. Work on said bridge to commence within six months from the time authority is granted by congress for the construction of the same, and to be finished within eighteen months from the commencement of work thereon.

WALTER BROWN, *Representing Company.*

North Topeka, Silver Lake & Rossville.—

TOPEKA, KAN., Dec. 19, 1887.

EDITOR ENGINEERING NEWS:

The proposed route of our road is from North Topeka *via* Menoken and Silver Lake to Rossville, a distance of 18 miles. The line will probably be completed and open for traffic by July 1. At present, however, a proposition to build another line is under consideration.

J. C. WATT, President.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Mexican National.—Ten miles of track have been laid, from Saltillo to the Buena Vista battle ground, and graders are at work on the line for fifty miles further south.

Denver & Rio Grande.—The extension from Montrose to Ouray, Col., a distance of 35 miles, has been completed.—It is rumored that the company is to let contracts at once for the extension from Glenwood Springs west.

Oregon Pacific.—NELSON BENNETT, who has a large contract on this line from Albany, Ore., east, has stopped work and discharged his employés. The company is said to be in financial straits. If this is the case, the report that the Chicago & Northwestern is interested in the road is probably untrue.

Northern Pacific.—On the Cascade tunnel, Contractor NELSON BENNETT reports a total of 7,300 ft. completed, leaving 2,660 ft. still to be bored. The total progress for November was 505 ft. On the Spokane & Palouse extension, under the same contractor, grading is completed and track is laid to Pullman, 85 miles from Spokane Falls, W. T., and 30 miles from the terminus at Genesee, Idaho.

Atchison, Topeka & Santa Fé.—Reports from Durango, Col., state that the company has offered for a loan of $30,000 to build a line from Albuquerque, N. M., to Salt Lake City *via* Durango. As the distance between the two termini mentioned above is something like 500 miles, and as the proposed route is through an almost uninhabited country and over some of the rockiest mountains of which the United States can boast, it seems reasonable to suppose that the Santa Fé or any other corporation will hardly build the line "this year" at least. When the line is actually constructed, it is likely that Durango and similar great cities along its route will be asked for aid of not quite so trivial an amount as the sum named above.

New Projects and Surveys.

San Diego & Elsinmore.—This company has been incorporated at San Diego, Cal., to build a railroad from San Diego to a connection with the Carson & Colorado road. It is stated that one of the incorporators is C. C. STEVENSON, Governor of Nevada.

Olympia & Chehalis.—The Board of Trade of Olympia, W. T., have had surveys made by F. W. BROWN of Olympia for a railroad from that city to the head of navigation on the Chehalis river, a distance of 70 miles. The route is stated to be favorable for construction.